Contingency Plan for Forest Damages of the Ministry of Agriculture and Forestry

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1 Introduction

Finland's National Strategy for Adaptation to Climate Change and *National Forest Programme (NFP) 2015* raise the issues of rising temperatures, increased precipitation and growing frequency of extreme weather events as likely consequences of climate change. Climate change is predicted to increase the likelihood of many types of forest damage. The three measures concerning climate change in NFP 2015 are the production of forecasts of forest damage risks, developing the forest damage monitoring system, and preparation of contingency plans for forest damages. The Action Plan for the Adaptation to Climate Change of the Ministry of Agriculture and Forestry 2011–2015 lays down concrete measures to implement the strategies: national and regional contingency plans for forest damages are updated, as necessary, and expanded to cover the most significant biotic threats, and coordination among the authorities in preparing for forest damages is improved.

The Government Resolutions on securing functions vital to society of 2003 and 2006 define the functions that are to be considered vital to society and the responsibilities of the different administrative sectors in securing these. The revised Government Resolution and Strategy for Securing the Functions Vital to Society were adopted in 2010. The strategy lays down the common foundation for preparedness and crisis management for all actors in the Finnish society. The strategy stresses a comprehensive and cross-sectoral perspective and, coordinated by the Cabinet Committee on Foreign and Security Policy, it has been updated in line with the anticipated development of our security environment and changes in the Finnish society in the next few years. The strategy is complemented by other strategies and steering documents relating to preparedness and management of incidents prepared by the different administrative sectors. The Government Resolution harmonises the preparedness at different ministries, following the division of tasks among the sectors and coordination provisions in the Government Rules of Procedure. The Resolution lays down the principles for the strategy implementation and monitoring and for the organisation of emergency drills. The ministries steer and monitor the implementation of tasks relating to securing functions vital to society and development of the necessary capabilities in their respective administrative sectors as regards all actors involved in this work.

Provisions on preparedness are laid down in Chapter 3 of the Preparedness Act. According to this, the Government, state administrative authorities, independent state institutes governed by public law, other government authorities and enterprises as well as municipalities, municipal federations and other coalitions of municipalities must, through contingency plans, advance preparation of action in emergencies and other measures, secure the best possible management of their functions also in crisis and emergency situations. The ministries coordinate the preparedness in their respective administrative sectors. Separate provisions are laid down on the coordination of preparedness within the government.

The Department of Forestry (from 2013 the Natural Resources Department) is responsible for preparing the contingency plan for forest damages and other preparedness actions together with the organisations in its administrative sector. In 2005 a preliminary action plan on preparing for forest damages was drawn up at the Ministry of Agriculture and Forestry. Two years later a working group composed of experts from the Ministry of Agriculture and Forestry, Ministry of the Interior, Forestry Centres and Forestry Development Centre Tapio drew up a National Contingency

Plan for Storm Damages. At the same time Regional Contingency Plans for Storm Damages were prepared in all regional Forestry Centres and heads of preparedness, with deputies, were appointed. The *National Contingency Plan for Forest Damages and its Implementation Plan* of 2009 expanded the preparedness to also cover forest fires, snow damages, damages caused by drought and cold, damages caused by long-range transmission of air pollutants and pests that did not use to occur in Finland, and storm damages.

The Contingency Plan for Forest Damages of the Ministry of Agriculture and Forestry expands the *National Contingency Plan for Forest Damages* to comprise the most serious biotic pests, including mammals, insects and fungi. It is founded on the Strategy for Securing the Functions Vital to Society, Contingency Plan of the Ministry of Agriculture and Forestry of 2012 and the National Contingency Plan for Forest Damages of 2009. *The Contingency Plan for Forest Damages of the Ministry of Agriculture and Forestry* replaces the National Contingency Plan. The Ministry's plan will be complemented by the new National Contingency Plan for Forest Damages prepared at the same time at the Finnish Forest Centre, where the focus is on concrete contingency and preparedness actions.

2 Threats to forests

In the Strategy for Securing the Functions Vital to Society Strategy for Securing the Functions Vital to Society a threat scenario is defined as *a general description of potential disturbances in the security environment*. The strategy describes 13 different kinds of threat scenarios, together with their mechanism of influence, source, target and impact at the target, likelihood as well as most serious disturbances identified for the threat scenario. Threats to forests may be considered to belong to the threat scenario "*major accidents, extreme natural events and environmental threats*".

From the perspective of the Finnish society the most likely extreme natural events are storms, heavy rains and sudden rise in water level, with the harmful impacts targeted, in particular, at the functioning of critical infrastructure. At worst extreme events may endanger human health and safety and cause an environmental disaster, which may also have permanent impacts on the environment and living conditions. The threat scenario of major accidents and natural disasters also comprises wind damages and fires, including forest fires. Environmental threats, in turn, may arise from human action or be a consequence of extreme natural events. Environmental threats are changes in the environment which may constitute a threat to the health and living conditions of the population by seriously damaging the preconditions for economic activities, including agriculture and forestry, contaminating water resources, endangering species and populations of living organisms and destroying infrastructure. Environmental changes may take place rapidly, in which case we are usually concerned with an environmental accident. Slowly evolving environmental threats, such as gradual contamination of the environment, may be difficult to observe. A serious environmental threat may arise from poorly planned use of industrial raw material, soil materials, forest resources, minerals or freshwater resources. Wrong kind of treatment of industrial or community waste may cause environmental threats, and these threats also include long range transmission of air pollutants damaging forests. Extensive forest damage caused by a pest which did not use to occur in Finland, such as pine wood nematode (*Bursaphelenchus xylophilus*) spread via timber and wooden packaging materials, may also be

considered an environmental threat. Besides the above, the Contingency Plan for Forest Damages covers damage caused by snow, drought, cold and air pollutants and biotic damages.

Climate warming is the most significant threat to the health and state of Finnish forests, after human action. Climate warming increases the risk of insect and fungal damages and is likely to lead to growing damage due to wind and snow. At present forest fires and air pollutant are no significant risk factors for Finnish forest nature. Both the Finnish Meteorological Institute and Forest Research Institute monitor the long-range transmission of air pollutants. Growing movement of people and goods brought about by globalisation increases the risk of spreading alien pests and diseases. Damages caused by different causal agents vary a great deal in terms of both time and place. There are species which in practice cause significant damage every year, such as annosum root rot (*Heterobasidion annosum*), pine shoot beetle (*Tomicus spp.*), Scots pine blister rust (*Cronartium flaccidum*, *Peridermium pini*), cervids and moles. Some species, such as pine sawfly (*Neodiprion spp.*), may cause damage in a certain area every 10 to 20 years, but at that particular time the damage is great indeed. The causes for variation in the damage may be linked to weather conditions and the forest management methods and strategies applied. This was the case for the Brunchorstia disease (*Gremmeniella abietina*) all across the country in the 1980s. The significance of the origin of the forest regeneration material as regards resistance to damage should be fully recognised.

The climate trends may involve several unforeseeable elements that will determine which of the causes of damage are more significant in the future than they are at presents. The dry and warm summers in the past few years and damages caused by storm winds have changed the range of pest and pathogen species and the impacts of the different species. There are also lags in the cause-effect relationships: for example, wind damages are often followed by damages caused by spruce bark beetle (*Ips typographus L.*) after one or several years. A pest population is capable of causing more extensive damage only after it has grown large enough; even dangerous pests are more powerful as a mass.

Enhancing forest biodiversity is among the basic pillars of Finland's National Forest Programme 2015. The breeding possibilities of damaging agents created by human action (summer felling, storage of unbarked timber, building) should be eliminated thoroughly, while disturbances that belong to the natural evolvement of forests and the opportunities these offer for increasing biodiversity should not be interfered with.

Threats to forests may occur alone or together with other threats. This is why the presence of several threats at the same time should be taken into account in the preparations. Provisions on forest damages are laid down in the Forest Damages Prevention Act (1087/2013). (Forest Damages Act), Government Decree on Regional Division Concerning the Transportation of Timber away from the Sites (1309/2013), Decree of the Ministry of Agriculture and Forestry on Alternative Measures to the Removal of Timber and Self-checking Notification (6/2014), and Act on the Protection of Plant Health (702/2003) and decrees issued under it.

2.1 Abiotic damages

2.1.1 Wind damages

Wind velocity exceeding the storm limit of 21 metres per second may cause damage in certain susceptible forest stands, but gusty wind may cause damage even at lower velocity. In the early 2000s there were three very powerful storms in Finland. Those named "Pyry" and "Janika" in late autumn 2001 when the ground was not yet frozen caused more than seven million cubic metres of trees to fall, while the "Unto" thunderstorm in July 2002 felled about one million cubic metres. During gusts the velocity was as high as 60 metres per second. After that there were no serious wind damages for eight years, until the four storms in July-August 2010 ("Asta", "Veera", "Lahja", "Sylvi"), which according to estimates of the Finnish Forest Research Institute cut down about 8.1 million cubic metres of trees. The most recent wind damages were at the end of 2011, when the winds blowing at storm velocities felled about 6.1 cubic metres of trees.

Forest stands at the margins of final felling areas and stands after thinning or fertilisation are more susceptible to wind damages. Soil softened by rain increases the risk of damages: after thawing when the soil is still wet strong wind may cause trees to fall with their whole rootstock. In the future climate warming may extend the period when the ground is not frozen and increase strong winds, thus causing a greater risk of wind damages. Climate warming is also forecast to increase the frequency of thunderstorms.

Trees felled by wind may cause disruptions in energy supply and damage buildings. Trees fallen across roads or railways may hinder transport. Secondary damage may be caused as pest insects often use fallen and broken fresh trunks as their breeding ground.

2.1.2 Forest fire

Usually forest fires are started by a struck of lightning or human negligence. In recent years forest fires have become increasingly common compared to the past decades, but thanks to aerial observation, more efficient methods to combat forest fires and denser and better forest road network the forest area damaged by fire has in fact decreased. Over the past decade the area affected by forest fires has varied between 200 and 800 hectares.

Climate change scenarios forecast a further increase in forest fires due to the longer summer periods, warming climate and increased evaporation. Strong winds also increase the risk of forest fires. In pine forests fire at the soil surface may spread at a rate of 15 to 30 metres a minute while crown fires may spread more than 30 metres a minute. In forests dominated by spruce and deciduous trees fire spreads much more slowly.

Stands that are the most susceptible to fire include over-dense young forests and old forests with a lot of dead trees. The risk is also high in regeneration areas with a lot of logging residue. Lichen and ground vegetation speed up the spreading of surface fires.

In the same way as storms, forest fires may cause disturbances in energy supply and damage buildings.

2.1.3 Snow

Compaction of wet snow and freezing of undercooled water in tree crowns may cause the three branches and trunks to break. The damage is even greater if this is combined with strong winds. Milder winters and increased frequency of storms may increase the damages caused by snow especially in northern Finland, but also in the south and along the Suomenselkä watershed.

The risk of snow damage is greater in fertilised forest where the tree tops have started to grow strongly, while the rootstock has not yet adjusted to the new situation. Pine is particularly sensitive to snow damages as it is not bent by the weight of the snow, which means that the whole tree may fall as more snow piles up. In spruce the snow burden is more evenly distributed along the trunk, and in most cases only the top is broken. In over-dense birch stands trees may stay at the pole stage, which significantly increases the risk of snow damage.

Often the damages caused by snow are very local in nature. Fallen trees may damage electricity lines and thus disrupt the local energy supply. Fallen trees may also damage buildings and hinder transport.

2.1.4 Drought and frost

Up until now drought alone has seldom caused extensive forest damage in Finland. In most cases long-term drought weakens the resistance of trees to pests and pathogenic fungi. Combined with a long warm spell in the autumn drought may weaken the wintering of trees, exposing them to frost damages.

Deciduous trees suffer more from drought than conifers because of the greater evaporation through the leaves. Of the conifers spruce is more sensitive than pine because its rootstock is closer to the soil surface and it has more needles. Yellowing caused by drought can first be seen in the crown. At worst drought may cause trees to die standing.

Longer periods of severe frost and strong variations in the temperature in a short time may damage the rootstock as well as needles and buds. Thin snow cover as well as scarce lichen layer in northern Finland may increase the risk of damage to rootstock. In pine frost-drought may reduce the annual needle volumes. In deciduous trees frost may cause cracks through which pathogenic fungi may spread in the trunk.

2.1.5 Long-range transmission of forest-damaging air pollutants

Of the air pollutants nitrogen oxides, sulphur dioxide and ammonia may cause forest soil acidification, thus contributing to nutrient leaching, slowing down microbial activity, as well as releasing harmful compounds for use by the plants. So far there is quite little information on the potential cumulative long-term effects of acid fallout and, on the other hand, on the ability of forest land to neutralise acids.

Nitrogen and phosphorus may cause eutrophication of forest soil. Nitrogen may also cause formation of harmful ground-level (tropospheric) ozone. In Finland the ozone levels are the highest in high-pressure conditions in the summer. Ozone formation is often the strongest far

away from the emission source, e.g. in the rural areas. High ozone levels may damage the meristem in trees and thus weaken their growth.

In Finland the air quality on average is good and the local effects of air pollutants remain small. At present the threats relating to long-range transmission of air pollutants are small.

2.2 Biotic damages

2.2.1 Economically the most significant damaging agents

Cervids

The amount of damage caused by cervids depends on the abundance of deer populations. The populations are regulated by hunting, and their monitoring is the responsibility of the Finnish Game and Fisheries Research Institute. The most detailed follow-up data on specific locations are available on damages to seedling stands caused by deer on private lands, which are recorded at the Finnish Forest Centre when compensations are applied for. For the whole country information on forest damages caused by moose is collected in the context of national forest inventories. Moose damages have a significant indirect effect on preventing annosum root rot as the regeneration of spruce stands affected by annosum root rot with deciduous trees has been difficult in areas with large moose populations.

Annosum root rot

In Finland there are two species of annosum root rot: *Heterobasidion annosum* and *Heterobasidion parviporum*. Of these *Heterobasidion parviporum* occurs only in spruce and larch, causing butt rot in these. It may also kill pine seedlings. *Heterobasidion annosum* occurs in multiple hosts and, besides causing pine root rot and butt rot in spruce, it causes deciduous trees to decay in mixed stands with pine and kills junipers. Annosum root rot causes greater economic losses to the Finnish forest sector than any other pathogen. The living habits of both fungi are well known: infestation of a healthy site takes place by spores via fresh stump surfaces or harvesting and other damages. In winter felling the risk of infestation is very low. Very likely the need for preventive action increases as the winters get shorter due to climate change. Because of climate change and increased cultivation of spruce the disease may spread further to the north. The exact range of either of the species is not known, however. Determining the exact range of annosum root rot and following its occurrence at regular intervals would allow better targeting of the treatment of tree stumps, thus improving its efficiency and economic profitability. Means to prevent root rot include felling at wintertime, rotation with deciduous trees, biological or chemical treatment of stumps and lifting of stumps.

Large pine weevil

Large pine weevil (*Hylobius abietis*) belonging to *Curculionidae* is the only pest in Finland and many other European countries that requires preventive action on a regular basis. Damages caused by large pine weevil occur in all regeneration areas with conifers in the preceding tree stand. The living habits of large pine weevil are well known. In southern Finland the generation time is two years, while in the north it may be as many as three years. Climate warming may accelerate the

ontogenesis of the pest, especially in the north. In practice it is impossible to forecast the gravity of damages caused by large pine weevils in specific regeneration sites because the risk depends on numerous factors in the forest regeneration chain and nearby forest stands (including time of felling, tree species composition, transport of wood from the site, lifting of stumps, collection of logging residue, storage of stumps and logging residue near the site, land tillage method, timing and type, and seedling size). To minimise damage, focus should be on training and advising people involved in forest regeneration and forest owners on the effect of changes resulting from regeneration and bioenergy harvesting on the risk of damage caused by large pine weevil.

2.2.2 Damaging agents with a high potential risk level

Spruce bark beetle

In Finland areas damages by spruce bark beetle (*Ips typographus L.*) are usually small in size, but in the other Nordic Countries, Central Europe and Russia there have been several cases where extensive wind damages and/or drought have been followed by damages caused by spruce bark beetle. Climate change increases the risk of bark beetle damage in the future. Spruce bark beetle is capable of killing healthy spruces when the pest population is large enough. Adult beetles overwinter in the soil, butt bark or under the bark of contaminated trees. Adult spruce bark beetles start to swarm when the temperature rises above +18°C. During swarming this blackish-brown beetle hits mature spruce of saw-timber size felled by wind, timber with bark on, jump butts or weakened standing trees, and breeds there. Weakened standing trees may be trees at the margins of felling areas exposed to the sun and over-aged spruce suffering from drought. The 10 to 15 centimetres long mother gallery of adult beetles runs vertically under the bark. When digging the mother galleries the beetles push the characteristic brown dust from under the bark. The larval galleries starting horizontally from the mother gallery are shorter. The larvae mature into new adults in about two months.

The warm summers of 2010 and 2011 were the first time when spruce bark beetles were reported to have produced two generations per summer in Finland. This phenomenon, well known in Central Europe, southern Sweden and Norway, may result in stronger pest populations in Finland as well. In some cases spruce bark beetles may lay eggs twice in a row, thus producing a second generation. Spruce bark beetle has a lot of natural enemies, but when a major damage has gotten started, in most cases these cannot stop it. Often damage caused by spruce bark beetle is noticed only when large strips of the bark of a dying tree start to come off, while most insects have already left the tree. Trees hit by spruce bark beetle in late spring-early summer often stay green far into the autumn, which makes it difficult to notice the damage in time. If spruces killed by spruce bark beetle are found in a forest, the trunks of nearby, healthy-looking trees should be examined at close distance. If small holes a few millimetres in size, brown ring of dust on the butt or resin leakage are observed, they have very likely been infested by spruce bark beetle. Such spruce should be identified in time and in southern Finland removed from forest before mid-July. The same applies to stocks of unbarked timber as well as groups of trees damaged by storm winds contaminated/inhabited by spruce bark beetle. When spruce bark beetle finds a suitable tree, it secretes aggregation pheromone, which is a luring substance and attracts more beetles to the site. Pheromone can also be manufactured synthetically to be used in pheromone traps as a means of prevention and monitoring. What is most important for prevention is that all suitable breeding material for spruce bark beetle is removed from forest to the extent required by the Forest

Damages Act. A high standard of forest hygiene is important especially in areas with an abundant pest population as a result of, for example, wind damages.

Spruce bark beetle is not a problem in over-aged forests alone, but the damages may also force to premature fellings in well-growing and appropriately thinned commercial forests.

In 2012 the Finnish Forest Research Institute, assisted by the Finnish Forest Centre, launched the monitoring of spruce bark beetle populations. The abundance of spruce bark beetle during the summer was monitored in 21 locations in different parts of Finland. Of these, the numbers caught exceeded the critical limit in four locations. In most locations within the whole area covered the numbers of spruce bark beetle were relatively low, but in the risk areas to the south of the Salpausselkä ridge the numbers of spruce bark beetle are clearly higher than in the earlier monitoring projects. Most of the felling due to damages caused by spruce bark beetle takes place in the same area. By the end of August 2012 the reported volumes of fellings due to damages were the highest in south-eastern Finland and Häme-Uusimaa region in the south. In total the regeneration area due to damages caused by spruce bark beetle in the whole country was more than 700 hectares.

2.2.3 Damages which may have significant impact locally

Pine shoot beetles

Common pine shoot beetle (*Tomicus piniperda*) and lesser pine shoot beetle (*Tomicus minor*) are blackish-brow bark beetles 3 to 5 millimetres long. They cause loss of growth in pine and unbarked timber to turn blue. The seldom kill healthy trees, but they may be fatal to trees that for some reason are weaker. In southern Finland pine shoot beetles usually start to swarm and hit pine timber, stumps, logging residue, trees cracked by snow, weakened standing trees and windfalls in March-April when the temperature rises above +11°C. In northern Finland their swarming usually starts in April-May. Common pine shoot beetle digs a vertical mother gallery and lesser pine shoot beetle a horizontal one under the bark of pine trunks. Wood with galleries dug by lesser pine shoot beetle turn blue very quickly, but common pine shoot beetle also spreads bluing fungi into trees. Larvae develop into new adults in about two months. Both old and young adults fly from under the bark to the top shoots of pines and bore into these for the rest of the summer to obtain nutrition. In the autumn the beetles move to the butt bark for overwintering. Shoots which have been hollowed out, perhaps more than a hundred in one tree, fall to the ground. The loss of growth may be tens of percentage points, and this may continue for years. Pines suffering from pine shoot beetles are easy to recognise from spiked crowns as the side-shoots have fallen down. In the worst years the total loss has been estimated to rise up to millions of cubic metres. The best way to prevent damages caused by pine shoot beetle is to remove trees damages by wind and snow and unbarked timber from forest before the end of June in southern Finland and by mid-July in the north.

Great pine web-spinning sawfly

In recent years the great pine web-spinning sawfly (*Acantholyda posticalis*) has caused serious damage in pine stands in the Pori region in western Finland. The larvae eat needles of all ages, often causing long-lasting damage. This insect used to be considered quite harmless, but now it

has resulted in premature final felling of more than 200 hectares of still growing forest. In test conditions biological prevention of great pine web-spinning sawfly using nematodes has been successful.

Needle cast

Pine needle cast (*Lophodermium pinastri*) and epidemics caused by it are more common in the south – in Estonia to the south of Finland severe epidemics are already quite frequent. Because of climate change the likelihood of similar epidemics exists at least in southern Finland. In the changing conditions *Lophodermella conjuncta* may turn into a more serious pathogen than it is at present. *Lophodermella sulcigena* occurs further to the north than the previous two, causing epidemics at least in more abundant pine stands. Recently red band needle blight (*Dothistroma septosporum*), which has cause significant damage especially in European black pine in Central Europe, has also been found in Finland. As yet it is difficult to estimate the significance of this in our country. The effect of spruce needle casts may also be growing.

Pine stem rust

Pine stem rust (*Cronartium flaccidum*) has for some time been considered as a fungal disease which lives in a dynamic balance with the host pine. In recent years, however, aggressive outbreaks which call for special attention have been observed in northern Finland and Sweden. In the future the research on pine stem rust should produce forest management recommendations concerning different types of pine stem rust for practical forest management purposes, also taking account of the risk of damage in sites susceptible to the different types. Extensive progeny and origin tests in pine breeding in northern Finland would allow to estimate the magnitude of hereditary disease resistance. Through this epidemics which in some places have turned chronic could in the future be prevented by means of resistance breeding. The longer growing period resulting from climate change improves the growing conditions of the intermediate host plants of virulent forms of pine stem rust. Because the disease occurs in all parts of Finland, pine stem rust epidemics may become increasingly common also in southern Finland, which is why changes in the occurrence of the virulent forms of the fungus should be monitored systematically.

2.2.4 Significant pests with strong seasonal variations

Moles

The dynamics in damages caused by moles have shown strong long-term trends, besides the shorter recurrence of 3 to 4 years. There were strong peaks in mole populations and damages in the 1970s and 1980s and in the early 1990s. For example, in the annual report of the federation of forest management associations of Central Finland of 1992 it is noted that mole damages were a far greater problem than damages caused by moose. After a period of less damage in the latter part of the 1990s the mole populations have again strengthened since the year 2000. The changes in food webs due to climate change have impacts on the dynamics of rodents and amount of damage. The occurrence of mole damages depends a great deal on the afforestation methods. For many tree species the varieties of southern origin are more susceptible to mole damages, and susceptibility is also influenced by growing methods at nurseries and time when the seedlings are planted. The increased cultivation of hybrid aspen and oak increases the need to protect the seedlings. The first cultivation programme for hybrid aspen failed largely due to the damages

caused by mammals. Besides the afforestation of arable areas, extensive moose and mole damages are among the reasons why the cultivation of birch has collapsed in our country.

Pine sawflies

European pine sawfly (*Neodiprion sertifer*) causes damage in pine stands in areas up to hundreds of thousands of hectares every 10 to 20 years. Adult insects fly and lay the eggs to the youngest needles in August-September. Larvae hatch from the overwintered eggs and start to eat the needles in May-June, leaving the new needles which develop during the same summer. This is why the trees may survive the damage reasonable well even for several years in a row. However, the loss of growth in pines may be several tens of percentage points and some of the weakened trees may die due to secondary damage caused by other insect species. Preventing the damage is seldom economically profitable because in most cases the damage abates by itself in a few years. In warm summers with little rainfall pine shoot beetles and pine weevils may kill trees weakened by sawflies. In extensive multiannual infestations biological prevention may be used by spraying young larvae with water which contains nucleopolyhedroviruses, where necessary, by aerial spreading.

Common pine sawfly (*Diprion pini*) is a more dangerous and slightly rarer species than the European pine sawfly. Adult insects fly and lay their eggs to the needles grown in the year before in May-June and, as a second wave, to all needles in July. The larvae may continue to eat needles of all ages until September. In the autumn the larvae descend to the ground where they pupate, overwinter and turn into adults in spring or summer. If the damage continues for two years or more, the trees may die. Common pine sawfly can only be prevented by synthetic pesticides, while so far there are no biological virus prevention preparations available.

Cone and seed pests

The cultivation of spruce has increased to a record high level and the trend continues. Spruce seed is produced in seed plantations, the aim being that all sowing at nurseries could be done using this cultivated seed. The use of cultivated spruce seed was the highest in the early 2000s, when 70-80% of the seed used in nurseries came from seed plantations. Now this share is as low as 20% as there is not enough cultivated seed available due to poor flowering of spruce and seed pests. By using cultivated seed the results of forest breeding could be transferred to practice, but at worst pests and rust fungi may destroy the whole cone crop. There are several pest species living in spruce, of which the most serious ones are spruce cone moth (*Laspeyresia strobilella*), spruce cone pyralid (*Dioryctria abietella*) and spruce cone maggot (*Strobilomyia anthracina*), as well as pathogenic fungi cherry-spruce rust (*Thekopsora areolata*) and inland spruce cone rust (*Chrysomyxa pirolata*). After diapause of a few years the cone and seed pest insects start swarming, always in a cone year. Frequent cone years increase the insect damages. The blooming of spruce is influenced by the weather conditions in the preceding year. Even if warm periods beneficial for blooming were to increase in the future, the pests may weaken the quantity and quality of the cone crop, even leading to shortage of seed. The possible increase in seed imports may lead to a wider range of cone and seed pest species in Finland. Chemical and biological prevention methods should be found for use in seed plantations. Prevention is based on understanding the life cycles, population variations and interactions of the species. Population monitoring methods and predictive models for insect damages in cone years should be developed for prevention purposes.

Immigrant species and invasive alien species

Immigrant species spread to the country naturally, for example, when changing climate makes it possible for the species to survive in Finland. Immigrant species constitute a risk that is difficult to predict. However, it is fully clear that in the future many new immigrant species will be coming to Finland, as shown by the appearance of alder rust (*Melampsoridium hiratsukanum*) and pathogen causing sudden death of oaks and more frequent occurrence of black arches (or nun moth, *Lymantria monacha*) over the past ten years. In the future problems may also be caused by species which do not yet cause actual damage, but may do so later own because of changes in the environment. Invasive alien species spread due to human action, intentionally or non-intentionally. Knowledge on immigrant and invasive alien species and species which may breed in Finland varies by species. For some species even the data known to exist are difficult to find. Among the most significant immigrant and invasive alien species in Finland have been white pine blister rust (*Cronartium ribicola*), which in the early 1900s destroyed the European white pine (*Pinus strobus*) plantations, and ash dieback (*Hymenoscyphus pseudoalbidus*), which is currently destroying Finnish ash stands.

The monitoring of invasive alien species is very challenging. The monitoring of quarantine species is the responsibility of the Finnish Food Safety Authority, in issues relating to forest species assisted by the forest damage information service of the Finnish Forest Research Institute. Among the potentially dangerous known immigrant and invasive alien species are pine wood nematode (*Bursaphelenchus lignicolus*), western gall rust, (*Endocronartium harknessii*) and Dutch elm disease (*Ophiostoma ulmi*). Of these the western gall rust is a microcyclic rust fungus of North American origin which spreads from tree to tree very rapidly and efficiently once it has entered a country and which is known to have caused serious damage in pines in North America.

Pine wood nematode is less than one millimetre long and it originates from North America. It lives in the wood material of conifers and may be spread from one tree to another by the insect vector long-horned wood borer of the genus *Monochamus*. After having hit a living tree it may cause the crown to dry very quickly. The nematode spreads in international wood trade in coniferous timber and packaging materials made from coniferous wood. Of the Finnish tree species pine is very susceptible to damage caused by pine wood nematode, which thus, if spread to our country, could be a threat to our whole pine population. As yet, however, there is no information on the ability of pine wood nematode to spread in cool conditions prevailing in Finland, which is why it is also difficult to estimate the extent of potential damage.

Dutch elm disease occurs to the south of the Gulf of Finland. It spreads via southern bark beetles of the genus *Scolytus*, which means that the predicted climate warming would very likely bring the disease to Finland. Dutch elm disease kills practically all large-sized elms but may leave the stumps, which may put out shoots for a long time after the epidemic has started.

Because the spreading or introduction of new damage causing agents to Finland cannot be avoided, all unidentified and strange incidents of damage should be reported to the Finnish Forest Research Institute. The forest damage information service of the Finnish Forest Research Institute maintains a database of forest damaging agents present in Finland and advice from the experts at the Research institute may be sought, where necessary. The Finnish Forest Research Institute notifies the Finnish Food Safety Authority of potentially dangerous plant pests.

3 Preparing for forest damages

Preparedness is based on the special situations in different threat scenarios. Preparation is composed of measures to ensure the undisturbed management of functions both in normal situations and in special situations and exceptional circumstances. Preparedness measures include preparedness planning, advance preparation and preparedness exercises.

3.1 Preparedness measures

3.1.1 Legislation

Functioning legislative instruments create the conditions for advance prevention of forest damages, rapid launch of measures in case of forest damages and situation management. The statutes must provide for the authority of different organisations and their responsibilities in a damage situation. Constant proactive work at various organisations speeds up and facilitates the launch of practical measures in case of forest damages.

Forest Damages Prevention Act (1087/2013) aims to prevent extensive damages caused by different damaging agents in forest trees. The Act applies to measures to prevent extensive damage caused by species already present in Finland. For example, the Act restricts the storage of fresh coniferous wood in forest in summertime. The owner of timber must remove coniferous roundwood with bark and with a basal diameter of more than10 centimetres prepared as roundwood assortments independent of the purpose of use of the from the felling and intermediate storage site within the time limits specified in section 3. Under section 6, the landowner is obliged to remove coniferous trees damaged by storm, snow, forest fire or other damaging agent or to undertake other necessary measures. Measures must to be taken if there are more than 10 solid cubic metres per hectare of damaged spruce trees and more than 20 solid cubic metres per hectare of damaged pine trees. A tree which is likely cause the spreading of forest damaging insects is considered as a damaged tree. By restricting storage the population numbers of pest insects can be kept sufficiently low to prevent them from causing extensive damage in forests.

Where an exceptional amount of insect or fungal damage occurs in a forest or the risk of appearance or spreading of extensive insect or fungal damage exists, the Ministry of Agriculture and Forestry may under section 9 of the Forest Damages Act order the landowners of the area concerned to remove a necessary number of trees from the forest or take other measures to prevent damage and its spreading. The Ministry may also order the Finnish Forest Centre to undertake prevention that calls for rapid actions. Priority shall be given to biological and mechanical means of prevention. In such cases the Finnish Forest Centre must present a proposal to the Ministry concerning the necessary measures.

Because of the climate change and warm spring temperatures the pest insects have started to swarm earlier than before. For example, the worst pest affecting spruce, spruce bark beetle, has in recent years been able to produce two generations per summer instead of one. This is why the legislation on preventing damages in forests has been revised.

The Act on the Protection of Plant Health (702/2003) applies to measures to combat plant pests not yet present in Finland and to prevent their spreading. The purpose of the Act is to maintain the good plant health status in Finland, thus promoting the operating conditions of agriculture and horticulture, food safety and product quality. The Act on the Protection of Plant Health is concerned with combating and preventing the spread of new plant pests or other organisms which may have unpredictable impacts and may constitute a direct threat to plant health. Further provisions under the Act have been laid down in the Decree of the Ministry of Agriculture and Forestry on the Protection of Plant Health (17/08). The supervision of plant health is the responsibility of the Finnish Food Safety Authority.

3.1.2 Preparedness and contingency plans

The National Contingency Plan for Forest Damages is prepared at the Finnish Forest Centre. The contingency plan may be complemented by additional regional information, taking account of the special characteristics of individual areas. The Contingency Plan of the Forest Centre is revised and updated on a regular basis to ensure that a proper state of preparedness is maintained and further improved.

Preparing for forest damages requires constant situation awareness as regards forest damages. The Finnish Forest Research Institute monitors the development of forest health and the Finnish meteorological Institute maintains an observation network for quality. The Finnish Environment Institute coordinates a monitoring programme of the environmental administration which also covers forest ecosystems. The safety weather service monitors the trends in the weather round the clock and sees to the warning and safety services relating to the weather that are important for public safety, both for the authorities and the public at large. The safety weather service sends out safety weather bulletins on a regular basis to the Finnish Forest Centre and the Ministry of Agriculture and Forestry.

3.1.3 Preparedness exercises

The functioning of the legislation, other advance preparations and the preparedness and contingency plans is tested in preparedness exercises, both nationally and regionally.

3.2. Abiotic damages

3.2.1 Wind damages

The adaptation of forest reproductive material to the conditions in a specific regeneration area is the basic condition for balanced development of the rootstock and shoots of the trees. Wind damages can be considerably reduced by selecting suitable tree species of the right origin. Spruce already suffers from drought in many places because it has been planted on too dry sites. Climate change is going to aggravate the situation, especially as regards spruce.

A viable stand with high resistance to wind damages can be created by good forest management after regeneration. The risk of wind damages can be reduced by thinning the stands early enough while avoiding excessive thinnings especially after fertilisation. A protective stand can be left at the margins of thinning sites that may be susceptible to wind damage. The susceptibility of stands

left at the margins of final selling sites may be reduced by good planning and demarcation of the sites. Extensive wind and snow damages may lead to a much higher risk of insect damages. Damaged trees may also serve as breeding grounds for harmful fungi, such as annosum root rot, which is why damaged coniferous trees should be as quickly as possible removed from areas suffering damage.

In harvesting trees damaged by wind the share of machine work should be considerably increased, mainly because of the danger involved. Damages caused by storm winds can to some extent be prevented in advance by good planning of fellings. The time when the wind damages occur is highly significant for organising the harvesting. Trees damaged by storm in the autumn, winter or spring may be harvested and damages repaired until the end of June of the following summer. In the case of storms occurring between June and mid-August the damaged trees in a spruce stand should be removed within a month or two from the storm to prevent a second generation of spruce bark beetle from developing, as may happen if the summer has been warm and dry. In harvesting trees damaged by wind the priority should be on spruce, because the pests living in pine are less dangerous than those dependent on spruce. Stands marked for felling with a lot of cut trees should be harvested before stands where trees have fallen with their rootstock. Pest are more prone to hit cut trees than trees fallen with their rootstock that are still living.

3.2.2 Forest fires

The Rescue Act (379/2011) lays down provisions on preventing forest fires and handling of fire in forests. The preparedness for forest fires and extinguishing them is the responsibility of the rescue service under the Ministry of the Interior.

According to section 6 of the Rescue Act, campfires or other open fires may not be lit if, because of drought, wind or other reason, the conditions are such that there is a manifest risk of a forest fire, gas fire or other fire. Section 31 states that, if there is a manifest risk of forest fires, the Regional State Administrative Agencies must organise an effective watching of forest fires in sparsely populated areas. Usually this is done by aeroplane. The Finnish Meteorological Institute must issue a forest fire warning for areas where, on account of weather conditions, the risk of forest fires is manifest. Under section 31 of the Act, anyone who observes a forest fire or other accident having occurred or a threat of these or receives information on these and cannot immediately extinguish the fire or combat the danger is obliged to notify those endangered, make an emergency call and take rescue action without delay to the best of his or her abilities.

Even in very dry conditions prescribed burning of forest land may be done in the presence of a forest professional, provided that special caution is taken. According to section 8 of the Rescue Act, the rescue department must be notified in advance of prescribed burning of forest land.

According to section 49 of the Rescue Act and section 4 of the Act on Metsähallitus (1378/2004), this state enterprise administering state-owned land and water areas is obliged to provide rescue authorities with expert assistance in combating forest fires and to prepare, on its own initiative, for the prevention and combating of forest fires in state-owned lands under its management in cooperation with rescue authorities. According to the rationale in the legislative proposal for the Act on Metsähallitus (HE 154/2004 vp.), preparation comprises plans for combating forest fires,

acquisition of the necessary equipment, and maintenance of transport connections necessary for combating fires.

Under section 49 of the Rescue Act, the Finnish Forest Centre is obliged, on request, to provide rescue authorities with executive assistance in forest fire matters that fall within its sector or are otherwise applicable to it.

3.2.3 Damages caused by frost, snow and drought

According to section 8 of the Forest Act (1093/1996) and section 2 of the Forest Decree (1200/1996), forest regeneration material used in regeneration must be suitable to the circumstances prevailing in the site as to its origin and other properties. Movement of regeneration material too far to the north should be avoided to avoid frost damages.

Pine stands that may be susceptible to snow damages should be thinned more moderately and frequently than in the recommendations. In birch stands the risk of snow damages can be reduced by avoiding overdense stands that lead to small stem diameter.

There are few forest management measures available to prevent damages caused by drought. Pine is better resistant to drought than spruce, which is why in the selection of tree species due account should be given to the adaptation of the species to the humidity conditions in the regeneration site.

3.3 Biotic damages

Biotic damages, i.e. damages caused by living organisms, are often difficult to identify. Often these involve several damaging agents, and abiotic damages may also be a condition for subsequent biotic damages or at least contribute these.

Identification of the damaging agents and specifying their contribution to the damage as a whole is often a condition for assessing the gravity of the damage and, in particular, for predicting the damage and preparing a management plan. Essential information also includes the extent of the area affected and variation in the degree of damage within the area. This information should be sent to the Finnish Forest Research Institute, which may assist in the identification and predicting of the damage and related management planning. Correct identification of the damaging agent "fresh" is the prerequisite for the assessment of the need for the consequent forest management measures. In the case of dangerous damaging agents capable of causing extensive damage, appropriate measures at the right time may prevent the damage from spreading. If there is no significant risk of spreading and the numbers of damaged or dead trees do not exceed the limits specified in the Forest Acts, no measures need to be taken.

The appearance and spreading of biotic damages can be efficiently prevented through appropriate forest management. Selecting the right tree species for each site is an important means of preventing damage in advance. In many cases preference for mixed stands and avoiding over-aged forests reduce the risk of damage. Locally, forest management should aim for a diverse age and tree species structure. Too monotonous stand structure increases the risk of forest damage, while preference for deciduous trees lowers the risk.

In thinning the quality of the work is highly significant. Harvesting damages increase the risk of further forest damage and reduce the growth potential and value of the remaining stand. Delays of forest management measures from the optimal time and the consequent intensive forest treatment increase the risk of wind damage. The thicker the tree is relative to its height, the better it stays standing. The best way of ensuring that trees grow in diameter is the appropriate timing of thinnings. Neglecting the management of a stand for a long time increases the risk of snow damage, especially in overdense pine and birch stands.

Measures taken to enhance and maintain biodiversity (prescribed burning, trees left/reserved in forest for biodiversity purposes, other restoration measures) may cause risk of damage to the surrounding stand. Such measures should always be designed so that the numbers of damaging agents do not rise too high. The means to do this include correct timing and scale of measures, monitoring the changes and immediate reaction to problems that may arise.

Heterobasidion root rot can be controlled by winter cuttings, tree species rotation and prophylactic control by stump treatment or removal. However, avoiding summer cuttings is not an economically feasible alternative since the forest industry is dependent on continuous cuttings. Tree species rotation is not possible on all soil types and the serious risk of moose damage prevents the usage of tree species rotation in many areas. Stump treatment with urea (chemical control) or a competing fungus (biological control) or stump removal are effectively quite similar prophylactic control methods. They efficiently reduce new infections but are of low value. Stump removal is economically feasible due to the bioenergy value but it causes changes in soil nutrient status and may therefore cause problems in the growth of the next tree generation.

It depends greatly on species which measure or technique is the best way of prevention. For example, damages caused by spruce bark beetle and pine shoot beetles can normally be reduced only by transporting the fresh timber and any damaged trees from the forest within the time limits specified in the Forest Act. Finnish Forest Research Institute is tasked

In most cases damages caused by insects can be prevented by means other than forest management measures. However, this is often not feasible because the costs and environmental damages due to this are greater than the benefits to be gained. There are only few pesticides registered for preventing forest pests. Spraying these to the crowns is technically challenging as aerial spreading is as a rule prohibited. Nowadays aerial spreading is allowed only if the Ministry of Agriculture and Forestry orders the forest owner to prevent extensive forest damage by means of state funding under the Forest Act, or the forest owners wish to prevent extensive forest damage on their own initiative, which is subject to a permit from the Ministry of Agriculture and Forestry.

Where a forest is threatened by extensive, serious damage, the Finnish Forest Centre may propose that the Ministry of Agriculture and Forestry should, under the Act on the Prevention of Insect and Fungi Damages in Forests, order the forest owners to undertake the necessary measures. These may be premature felling, treatment of trees or biological prevention, which the Finnish Forest Centre may organise on behalf of all forest owners. Biological prevention under the Act has been used twice, first in the prevention of European pine sawfly in Uusikaupunki in 2008 and then in controlling the occurrence of great pine web-spinning sawfly in Yyteri in 2011 and 2012. Such prevention operations are always planned in cooperation between all relevant stakeholders.

3.4 Damages caused by pine wood nematode

Preparation for damages caused by pine wood nematode is based on the Contingency Plan of the Finnish Food Safety Authority last updated in 2011.

3.5 Damages to forests caused by air pollutants

Preparing for damages caused by long-range transmission of air pollutants is based on international agreements and actions by the European Union. The Clean Air For Europe (CAFE) programme and Thematic strategy on air pollution were completed in 2005, defining the future air quality objectives and searching for solutions for reducing, for example, ground-level (tropospheric) ozone, acidification and eutrophication.

The Finnish Meteorological Institute under the Ministry of Transport and Communications maintains a background air quality monitoring network and develops prediction and monitoring models on the transformations and transmission of air pollutants. Ground-level ozone levels are measured constantly at several air quality background stations, and too high ozone levels are communicated on the radio and TV. The municipal environment authorities measure air quality at almost 120 stations in different parts of the country. The Finnish Environment Institute measures the quality of rainwater and the Forest Research Institute follows the amount and type of fallout in coniferous forest stands (Environmental monitoring in Finland 2009-2012, Finnish Environment Institute).

Preparation for damages caused as a result of long-range transmission of air pollutants is based on the report *Grounds for preparation and contingency planning* drawn up by a working group appointed by the Ministry of the Environment (Ministry of the Environment 2008).

4 Division of responsibilities relating to forest damages

4.1 Ministry of Agriculture and Forestry

The task of the Ministry of Agriculture and Forestry is to steer the policy on renewable natural resources in Finland, which also covers the safety and quality of foodstuffs produced from natural resources and animal and plant health. According to the principles of sustainable development, natural resources must be used in a way that their economic, ecological, social and cultural value remains unimpaired also for the future generations to enjoy. Among the main tasks of the Ministry is to create the conditions for production activity based on the renewal capacity of natural resources and promote the further improvement in the safety and quality of foodstuffs produced from natural resources. It is also important to secure the viability of the rural areas, which can be promoted by diversifying the economic activities and maintaining and developing fisheries and hunting and other recreational activities in the countryside and caring for the rural environment.

The **Permanent Secretary** of the Ministry of Agriculture and Forestry steers and controls the Ministry's activities and sees to the preparation of the objectives and follow-up of their implementation. The Permanent Secretary, assisted by the **Head and Secretary of Preparedness** in the practical implementation of tasks, is responsible for preparedness, safety and security in the

administrative sector - in line with the strategy. The **meetings of the Permanent Secretaries and Heads of Preparedness** of the ministries are permanent cooperation bodies for preparedness matters as well.

The Forests and Bioenergy Unit of the Natural Resources Department is responsible for the implementation of tasks relating to forest damages and developing capabilities required for this in the administrative sector. The Unit is also responsible for legislative preparation relating to preparedness and the assessment of the extent and gravity of forest damages of national significance.

The Director-General of the Food Department steers the measures to combat damages caused by plant pests earlier not be present in Finland. The Animal and Plant Health Unit of the Food Department prepares the legislation on plant pests that did not use to occur in Finland and makes the administrative decisions required for special situations involving these, assisted by the Forests and Bioenergy Unit when forests are concerned. The practical prevention measures are taken by the Finnish Food Safety Authority.

4.2 Ministry of the Interior

The Ministry of the Interior steers and controls rescue actions and access to and standard of rescue services as well as sees to the related national preparations and arrangements. The Ministry also coordinates the actions by different ministries in rescue services.

4.3 Ministry of the Environment

The Ministry of the Environment steers the implementation of tasks relating to the prevention of environmental degradation and harmful changes in the atmosphere and the development of capabilities required for these in its own administrative sector. The Ministry is also responsible for the implementation of international agreements relating to long-range transmission of air pollutants.

4.4 Emergency Response Centre Administration

The provisions on the Emergency Response Centre Administration and production and development of emergency response services are laid down in the Act on the Emergency Response Centre Service (692/2010). The Emergency Response Centre Administration supports the rescue service, police, social service and health authorities by forwarding messages, communications and tasks to these. Warning the citizens in acute emergencies and other support for the action by the authorities are also the responsibility of the Emergency Response Centre Administration.

4.5 Rescue authorities

The state rescue authorities are the Director-General of the Department for Rescue Services and the appointed public servants of the Ministry and Regional State Administrative Agencies. The highest-ranking public servant of the rescue department, their appointed public servants and the

relevant multi-member body of the regional rescue services are the rescue authorities of the regional rescue services.

The rescue department sees to the management of task relating to rescue operations when a fire or other accident or a threat of these calls for urgent action to protect or rescue human life or health, property or the environment and the action cannot be taken by those affected by the accident or threat or it belongs to another authority or organisation.

If authorities from different sectors are involved in the rescue operation, the officer in charge of rescue operations functions as the general situation manager. The situation manager is responsible for maintaining an up-to-date picture of the situation and coordination of activities. Units in different sectors operate under their own leadership so that their activities combined contribute to the efficient prevention of an accident or consequences of the situation. Where necessary for assistance, the situation manager may convene a steering group of representatives of various authorities, institutes and voluntary units participating in the operations and invite experts to join in.

To extinguish a fire and prevent it from spreading, prevent other accidents, limit damage and prevent dangerous situations from arising the regional rescue authority and rescue authority of the Ministry of the Interior have the right to order people to protect themselves and evacuate people and property and take necessary action that may cause damage to immovable or movable property. The rescue authority also has the right to order buildings, communications links and equipment, as well as equipment, supplies and implements, foodstuffs, fuel and lubricants, and extinguishing agents to be made available and to take other action required for rescue operations.

The rescue authorities steer the rescue services to the extent this is concerned with protecting humans, animals and property. Where necessary, they request assistance required by a specific situation (request for executive assistance) from the Finnish Forest Centre or Metsähallitus and other assistance needed in the situation from actors in the forest sector and electricity distribution companies. The rescue authorities are responsible for communication concerning rescue action and, where necessary, they have the right to issue emergency and official bulletins.

4.6 Regional State Administrative Agency

The Regional State Administrative Agency supervises the rescue services as well as access to and standard of rescue services in its area of operation. The Agency also reports on the access to and standard of rescue services to the Ministry of the Interior, assists the Ministry of the Interior in the acquisition of information necessary for steering the rescue operations and maintaining the picture of the situation, participates in the planning and organisation of disaster exercises to promote cooperation between rescue departments and other parties involved in rescue operations, and otherwise promotes collaboration between different stakeholders in rescue services in the operating area.

The Regional State Administrative Agency must also organise efficient observation of forest fires in sparsely populated areas if there is a manifest risk of a forest fire.

4.7 Finnish Forest Centre

According to the Act on the Finnish Forest Centre (418/2011), the tasks of the Forest Centre include promoting the sustainable management and use of forests and preservation of their diversity. The tasks also include preparing for forest damages and provision of executive assistance referred to in the Rescue Act. Preparing for forest damages comprises the preparations for forest fires, storm and wind damages and insect and fungal damages.

Under section 49 of the Rescue Act, the Forest Centre is obliged, on request, to provide rescue authorities with executive assistance that falls within or is otherwise applicable to its field of activities. Under section 47 of the Rescue Act, the Forestry Centre must prepare the necessary plans for carrying out their duties in connection with rescue operations and for participation in rescue operations. Rescue departments must be provided with accounts of the resources available for rescue operations in order that the rescue departments know what kind of assistance the Forest Centre is capable of yielding in different situations. According to section 95 of the Rescue Act, the costs of rescue services are the liability of the party that is obliged to carry out the measure or task or to attend to it. The responsible parties specified in individual provisions of the Rescue Act are liable for the costs relating to tasks that are in their responsibility.

According to the Act on the Protection of Plant Health (702/2003), the Finnish Food Safety Authority may seek the assistance of the Finnish Forest Centre in the preparation and implementation of a prevention decision referred to in section 11 and preparation of a decision on compensation referred to in section 30 a if the prevention concerns a plant pest earlier not present in Finland which may cause direct or indirect damage to trees growing in forest.

According to the Decree on the Monitoring of Plant Diseases and Pests Causing Forest Damages (1045/1991), the Finnish Forest Centre is obliged to assist the Finnish Forest Research Institute in monitoring the occurrence and spreading of plant diseases and pests causing forest damages.

The Regional Forestry Centres drew up a Contingency Plan for Storm Damages in 2007. The Finnish Forest Centre set up in 2012 is tasked with preparing a National Contingency Plan for Forest Damages. The plan describes the internal preparedness organisation of the Finnish Forest Centre and its tasks in different situations, and it also contains anticipatory cooperation among different organisations. The plan must also show the organisation of the preparedness for forest damages on the regional level and tasks of the organisations involved. Special attention should be paid to request for executive assistance from the police and capability of the Finnish Forest Centre to yield necessary executive assistance when requested by the rescue authorities. The plan is updated on a regular basis and preparedness is further improved by means of new information and experiences. The actions required by the National Contingency Plan for Forest Damages are included in the operative systems of the Forestry Centres.

4.8 Finnish Forest Research Institute

According to the Act on the Finnish Forest Research Institute (798/2009), the Institute monitors the trends in forest resources, forest health and utilisation of forests and carries out scientific research and development work. Besides the international monitoring programmes, the Institute follows the health of forests in national forest inventories, repeated in the same area every 5-8

years. The monitoring of forest health also includes a general assessment of the need to combat damages caused by insect, fungi and mammal species that are native to Finland.

Many of the research projects of the Finnish Forest Research Institute are concerned with the occurrence of forest damages and secondary damages and developing methods for mapping forest damages.

4.9 Metsähallitus

Metsähallitus is a state enterprise which administers state-owned land and water areas. According to section 49 of the Rescue Act and section 4 of the Act on Metsähallitus, Metsähallitus is obliged to provide expert assistance to rescue authorities and prepare, on its own initiative, for the prevention and combating of forest fires occurring on state lands it administers together with the rescue authorities. To prepare for forest fires, fire prevention plans need to be drawn up for state lands. Where necessary, this is done in cooperation with the Natural Heritage Services to ensure that due account is given to fire protection in both commercial forests and protection and recreation areas. The Forestry and Natural Heritage Services business units submit the prevention plans for forest fires, with the relevant contact information, annually to the rescue service of the Regional State Administrative Agency. The rescue authorities keep national statistics on forest fires. Metsähallitus sees to the statistics on forest fires which occur in the lands it administers in its own registers, together with other forest damages. The data on forest compartments are also updated with the forest fires which have occurred. The environmental and quality system for forestry and environmental guide of Metsähallitus contains detailed instructions on preparing for forest fires and forest damages.

According to section 47 of the Rescue Act, the authorities, institutes and state and municipal enterprises that are obliged to provide rescue authorities with executive and expert assistance or whose expertise is otherwise required in rescue operations and in the preparation for these are obliged to prepare, under the direction of rescue departments and in cooperation with each other, the necessary plans for carrying out their duties in connection with rescue operations and for participation in rescue operations. Rescue departments must be provided with accounts of the resources available for rescue operations. The tasks of Metsähallitus are specified in the Contingency Plan for Storm Damages of the Finnish Forest Centre. Metsähallitus is responsible for the harvesting of trees damaged by wind in state forests and the related occupational safety and it also informs the Finnish Forest Centre of the measures required due to a storm.

According to the Decree on the Monitoring of Plant Diseases and Pests Causing Forest Damages (1045/1991), Metsähallitus as the body administering state-owned forests is obliged to assist the Finnish Forest Research Institute in monitoring the occurrence and spreading of plant diseases and pests causing forest damages. Metsähallitus is prepared to combat and minimise biotic and abiotic damages through forest management measures, with detailed instructions for specific types of damage. Instructions have also been drawn up for the changing environment and the possible forest damages and spread of invasive alien species resulting from this. Forest health is monitored in connection with other activities as well as, where necessary, in special studies. Significant damages are recorded in the Geographical Information System. Once a year all data on forest damages compiled at Metsähallitus are put together and delivered to the Finnish Forest Research Institute for the national monitoring of forest damages. As instructed by the Institute, branch

samples are collected, where necessary, for the monitoring of e.g. pine sawflies. Each year the persons in charge of land use and environmental issues in the regions compile the forest damages in their respective regions to a monitoring table for forest damages.

4.10 Finnish Food Safety Authority

The Finnish Food Safety Authority is responsible for the implementation of the Act on the Protection of Plant Health. The Finnish Food Safety Authority has contingency plans for pine wood nematode and other pests which are not yet present in Finland and is responsible for the measures to combat the damages caused by these.

4.11 National Land Survey of Finland

The National Land Survey of Finland prepares for natural events and disasters by aerial photography as specifically agreed with the Ministry of Agriculture and Forestry.

4.12 Parties authorised by forest owners

Parties authorised by forest owners, including forest management associations, forest service enterprises and forest industry companies, are responsible for planning the harvesting of damaged trees and occupational safety in harvesting work. Damaged or fallen stemwood with commercial value should be utilised as quickly as possible.

Parties authorised by forest owners report the forest damages which have occurred and their extent to the Finnish Forest Centre in a way to be specifically agreed with the Centre.

4.13 Forest industry companies

In the legislation no specific role has been laid down for forest industry companies as regards forest damages. As holders of the felling rights or forest owners they are responsible for planning the harvesting of damaged trees and occupational safety in harvesting work. As far as possible, they should target the harvesting equipment for damaged trees and staff to the area affected so that damaged stemwood with commercial value can be utilised in the production processes of the forest industry.

The companies decide the storage locations they use in the harvesting of damaged trees (industrial premises, roadside or water storage) and keep a register on the stocks in a way to be specifically agreed with the Finnish Forest Centre.

4.14 Electricity companies

Electricity companies prepare contingency plans of their own for forest damages, keep them up to date and see to the related training. They are also responsible for the operating state of their electricity networks and management and repair of defects. According to section 5 of the Electricity Market Act, the distribution network holder must have a sufficient staff in its service for conducting the electricity network operations. If the maintenance and repair of the network has

been delegated to a separate company, the network holder must ensure by appropriate contractual arrangements that in the event of major disturbances there is a sufficient staff available.

4.15 Other parties

The Finnish Meteorological Institute maintains a background air quality monitoring network and develops prediction and monitoring models on the transformations and transmission of air pollutants. The safety weather service of the Finnish Meteorological Institute sends a safety weather bulletin to the Head of Preparedness and his or her deputy as well as to the Ministry of Agriculture and Forestry.

The environmental authorities supervise the compliance with the legislation concerning nature and environmental protection. In the event of problem situations the actors contact the regional Environment Centre. The Finnish Environment institute coordinates the monitoring programme of the environmental administration, which also includes forest ecosystems.

Insurance companies have no statutory role in forest damages, even if insurance compensations can still be highly significant for forest owners. Insurance contracts are concluded between the insurance company and forest owner. By the insurance contract the company is usually given the opportunity to inspect the damage before any timber harvesting is undertaken. Each insurance company may decide separately what kind of assessment or other services it wishes to purchase from the forest sector organisations.

5 Communication on forest damages

The main principle of communication in public government is particularly important in damage situations. The increased need for information of the citizens and media requires a response that is rapid, reliable, and as open as possible.

Communication must be started at the earliest stage possible. Communication must be started on the initiative of the relevant parties, systems must be in place that it can be launched rapidly, and it must be active and consistent. The magnitude of the situation, estimated duration and possible protection and prevention measures must be explained in a manner that is readily understood.

The Finnish Forest Research Institute, Finnish Forest Centre and Metsähallitus must notify the Ministry of Agriculture and Forestry without delay of extensive and sudden forest damages or other crisis situations which may involve forest damages. The Forests and Bioenergy Unit of the Natural Resources Department (until 2012 the Department of Forestry) immediately notifies the top management of the Ministry and Media and Communications Unit of the situation. The top management and Media and Communications Unit are constantly kept informed of the measures taken to resolve the situation.

National communication on forest damages is based on the communication guide for crises and special situations of the Ministry of Agriculture and Forestry, which is the responsibility of the Media and Communications Unit. Within the Ministry the Media and Communications Unit is responsible for communication in collaboration with the Forests and Bioenergy Unit. National

communication on forest damages in the responsibility of the Ministry and the Finnish Forest Centre, and the latter is responsible for regional communication and communication on the enforcement of orders by the authorities in accordance with guidelines prepared for this purpose. The Finnish Forest Research Institute and Finnish Food Safety Authority communicate in accordance with their own guidelines, in cooperation with the Ministry of Agriculture and Forestry.

The rescue authorities have the overall responsibility for communication during rescue operations. Where necessary, the rescue authorities may issue emergency and official bulletins. Electricity distribution companies are responsible for communication to regions where electricity supply has been disrupted.

6 Literature

Hyvän metsänhoidon suositukset. *2006.* Metsätalouden kehittämiskeskus Tapio. 59 s.
(Recommendations for Good Forest Management. 2006. Forestry Development Centre Tapio; in Finnish)

Ilmastonmuutoksen kansallinen sopeutumisstrategia. *2005*. Maa- ja metsätalousministeriön julkaisuja 1 / 2005. ISBN 952-453-200-X. 278 s.
(Finland's National Strategy for Adaptation to Climate Change. 2005. Publications of the Ministry of Agriculture and Forestry 1a/2005.)

Kansallinen Metsäohjelma 2015 –Valtioneuvoston periaatepäätös. *2010*. Maa- ja metsätalousministeriö. ISBN 978-952-453-630-1 55 s.
(Finland's National Forest Programme 2015 - Government Resolution. 2010. Ministry of Agriculture and Forestry.)

Maa- ja metsätalousministeriön valmiussuunnitelma. *2012*. 27 s.
(Contingency Plan of the Ministry of Agriculture and Forestry. 2012; in Finnish)

Metsätuhoihin valmistautuminen – taustapaperi metsäkeskuksen metsätuhovalmiussuunnitelmaa varten. *2012*. Metsäntutkimuslaitoksen ohje. 11 s.
(Preparing for forest damages - background paper for the Contingency Plan for Forest Damages of the Finnish Forest Centre. 2012. Guideline of the Finnish Forest Research Institute; in Finnish.)

Valmiussuunnitelma mäntyankeroisen varalle. *2011*. Eviran julkaisuja 7/2011. ISBN 978-952-225-089-6.68 s.
(Contingency Plan for Pine Wood Nematode. 2011; in Finnish)

Suomen ympäristön seuranta 2009-1012. *2009*. Suomen ympäristö 11/2009. Jorma Niemi (toim.) Suomen ympäristökeskus, ISBN 978-952-11-3412-6.
(Environmental Monitoring in Finland 2009-2012.2009. Finnish Environment 12/2009. Jorma Niemi (editor). Finnish Environment Institute.)

Valtakunnallinen metsätuhovalmiussuunnitelma ja sen toimeenpano. *2009*. Maa- ja metsätalousministeriö. 19 s.
(National Contingency Plan for Forest Damages and Its Implementation. 2009. Ministry of Agriculture and Forestry; in Finnish.)

Varautumisen ja valmiussuunnittelun perusteita. *2008.* Työryhmän selvitys. Ympäristöministeriö. 52 s.
(Foundations for Contingency and Preparedness Planning. 2008. Working group report. Ministry of the Environment; in Finnish.)

Yhteiskunnan turvallisuusstrategia. Valtioneuvoston periaatepäätös. *2010*. ISBN 978-951-25-2169-2. 93 s.
(Security Strategy for Society. Government Resolution. 2010.)

7 Contact information

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Forest health information service
http://www.metla.fi/metinfo/metsienterveys/

Forest damages reports
http://www.metla.fi/metinfo/metsienterveys/tuhoilmoitus/index.htm