ShortCuts

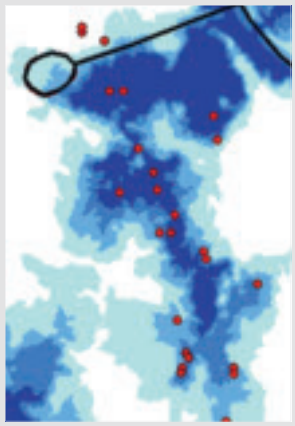
FROM SKOGFORSK. NO 1 | 2014 | RESEARCH FOR TOMORROW'S FORESTRY

RIGHT METHODS CAN HALVE GROUND DAMAGE

THEME CLIMATE

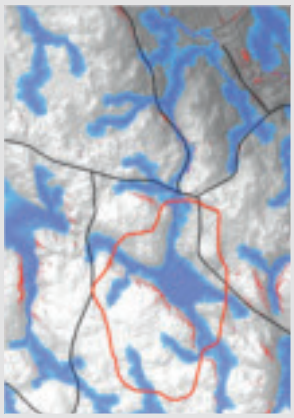
READY FOR THE CHALLENGE?

HELPING FORESTRY ON THE CLIMATE JOURNEY:
"WE'RE BUILT FOR CHALLENGES"



"Unacceptable". The most serious damage usually occurs on damp and wet ground. But this damage can be avoided with the soil moisture map.

Traditional felling tract.



Same area shown with a terrain model and soil moisture map. Today's information compared with tomorrow's.

STILL MUCH UNACCEPTABLE GROUND DAMAGE, BUT…

"FORESTRY CAN TURN THIS AROUND"

Training courses. Ground damage guarantees. Common policy for avoiding ground damage. Nevertheless, the serious ground damage that the forestry sector deemed 'unacceptable' is still common.

"Our follow-up is not particularly encouraging," says Isabelle Bergkvist of Skogforsk. "BUT… it also shows there is great potential for completely avoiding serious damage."

Text & photo: SVERKER JOHANSSON, bitzer@live.se

In 2012-13, in the STIG project, Skogforsk surveyed logging areas with regard to ground damage, and investigated how these cases of damage could be avoided. In the project, Skogforsk collaborated with four forestry companies on total area of 433 hectares, divided into 36 fellings from Småland to Dalarna.

"It's like this"

Skogforsk's study can be said to be a snapshot of the current situation – after extensive training initiatives but before new methods and technologies have started to make a serious breakthrough. In total, the number of cases of damage averaged 6 per hectare, and ranged from 2 to 11 cases/ha. On average, 0.5-1 (0.77) cases of damage per hectare are classed as serious ('unacceptable' according to the Forestry Sector Ground Damage Policy).

If this is representative of the entire forestry industry, it would mean approximately 200 000 cases of unacceptable damage per year, on final-felling areas alone.

"Machines are consistently driven too close and too far out into the damp and wet areas," says Isabelle Bergkvist. "That's where most serious damage occurs. There is also some serious damage on solid ground, but there it's because machines have been driven over conserved areas or areas of cultural preservation. That's another problem. But that's what it's like today."

At the same time, Isabelle Bergkvist feels the survey is not without hope for the future.

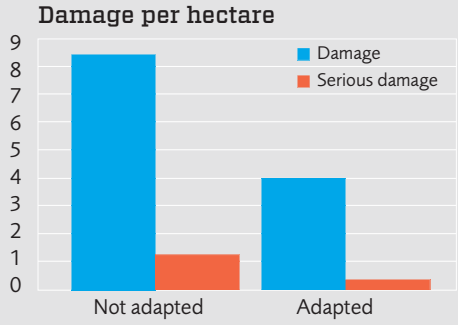
"The forestry sector can turn this around. Firstly, in the study areas where the machine teams were working, the focus was on a carefully planned, adapted method, and brushwood was placed where it was needed according to the 'Right method' (see Vision 1/13, ed.). Here the cases of damage were halved, and the cases of serious damage only a third as many. So using a good method and working according to the right procedures can bring revolutionary results.

"And, secondly, the serious damage usually occurs on damp and wet ground. With soil moisture maps in the machines, and a GPS link, the operators can avoid most of this damage. If they know the location of the wet areas with less bearing capa-

Soil moisture maps – in our machines soon?

The calculation model, from Canada, identifies moist and wet ground on the basis of the height and slope of the land in relation to the surroundings. Data comes from airborne laser scanning, and the model calculates where the groundwater is less than 1 m below the surface.

"Of course, the model can be developed for Swedish conditions, but as someone said: water flows in the same direction in Canada as it does in Sweden," comments Isabelle Bergkvist.



Damage more than halved. In three of the areas, an adapted method was used in felling. Here, damage was halved, and the serious damage was reduced by no less than 65 percent.

city, and also have clear and precise procedures for minimising driving on or protecting the ground with greatest loading, much is won. Or simply avoid the areas shown in blue on the soil moisture, and avoid the damage completely!"

Already available

In the study, the accuracy of the soil moisture maps was also evaluated. The results showed less than 35 percent deviation between the model and the physical survey. Only in 7 percent of the deviations was the soil moisture underestimated in the model. For example, ditches and road embankments seem to affect the model – the model can be developed for Swedish conditions so ditches and roads can be taken into account.

"But we should still start using the soil moisture maps in planning and logging operations as soon as possible," says Isabelle Bergkvist. "This will reduce the damage considerably."

The project is continuing in 2014, and will test models and procedures in practical planning and felling, with the aim of avoiding serious damage. Together with Skogforsk's BesT project, which aims to develop analysis tools for optimised forest transport, the STIG project is part of Skogforsk's strategic initiative. A reference group from the forestry sector is helping in project planning and implementation, to improve the link to practical application and to facilitate implementation.

"We'll be introducing the technology in a handful of machine teams, and evaluating the logging result on equivalent areas and numbers of tracts as in the previous study. There will be differences in terrain and weather conditions, but the size of the experiment means that we will be able to assess how well we succeeded in the aim of completely avoiding serious damage through improved tract information and clear procedures."

HELPING FORESTRY ON THE CLIMATE JOURNEY:

Marie Larsson-Stern is head of the Skogforsk research area Forest Production. Previously, she was silviculture manager at Sveaskog, and she is well aware of how closely forestry and researchers must work if research results are to be disseminated and applied.

Text & photo: SVERKER JOHANSSON, bitzer@live.se

"As climate changes, so does forestry," she says. "Our job is to help the sector secure its activities for the future. This involves both long-term strategic work – for example, breeding trees that are adapted to a warmer climate – and more operative issues, like developing felling methods less detrimental to the environment when temperatures and rainfall are increasing.

"These issues span many areas. Operating machines in ways that cause less damage requires good ideas from the practitioners – operators and planners – but also from soil and water researchers, GIS experts and machine manufacturers. And that's why I say we're built for the challenge: we put together researchers from many different disciplines, and we also have close collaboration between researchers and forestry. Together, we make things happen.

"And that's important, because climate change is already becoming evident," continues Marie Larsson-Stern. "We're now, for example, changing our recommendations for growing spruce and pine – the climate is already warmer than when the recommendations were first made."

If you were to choose three important climate issues to prioritise from now on, what would they be?

"Forest tree breeding is, of course, vitally important – to develop robust growing material that is adapted to tomorrow's climate," says Marie Larsson-Stern. "We must reduce ground damage caused by forest machines – it's not just soil and forest production that are affected, but also water in the landscape. And then we must work more smartly and with better technology to reduce carbon dioxide emissions."

"WE'RE BUILT FOR CHALLENGES"

WHAT SKOGFORSK IS DOING! CHANGING CLIMATE

Forest tree breeding
- Spruce and pine. Development of functions for moving spruce and pine, studies of bud flush and winter hardening as a basis of climate-related damage problems. Testing of regeneration material outside the intended area of use.
- New tree species. More intensive breeding of species like hybrid larch, Sitka spruce, Douglas fir and poplar.
- Deciduous trees. Preparations for genetic resource management – including species that are not commercially used today.
- Decision support, for example Frost Risk and Plant Selection in KUNSKAP DIREKT.

Silviculture and Environment
- Soil and water issues. Studying the effect of forestry on soil and water, to limit and avoid the most serious mistakes. Better data for planning, method development, training, and research into leaching of sludge and nutrients.
- Forest planting and silviculture. Evaluation of new tree species and development of silvicultural methods. On the new experimental plots at Furudal National, spruce and pine are being studied, including variations in growth and quality in relation to soil properties and climate (e.g. latitude and altitude).
- New thinning templates (INGVAR). Adaptation to earlier and fewer thinnings, because of risks such as spreading root rot, ground damage, and more storms.
- Grazing by wild animals. Long-term national experimental series, Furudal National, with 21 experimental areas. Studies of the effects of grazing on forest will continually increase knowledge and provide better forecasting tools for the future.

Forest operations and products
(in collaboration with Forest Energy)
- Lower resource use: less fuel consumption; ETT Project (large haulage rigs); machine resource optimisation.
- Method development/training (RECO), which addresses issues such as the problem of ground damage, including harvest of energy wood and stump lifting. Collaboration with Planning and Silviculture and Environment.
- Forest roads. Development of models for benefit calculation; new construction and maintenance (frost, thaw, autumn rain).

Operational Planning & Logistics
- More efficient logistics; route optimisation; more efficient planning of roads; smart, environmentally sound road choices; placement of terminals for efficient road/rail transports.

Forest Energy
- Greater use of forest fuel – less dependence on fossil fuels. Increase the proportion of renewable energy.
- Quality of forest fuel. Studies on thicker chip fractions, less wear on comminution equipment, and reduced fuel consumption. Greater combustion efficiency, produces more power in the boiler, and reduces emissions. Research aimed at producing drier fuel that can be transported and incinerated in ways that are less environmentally damaging.

Miscellaneous
- KOSS (consequence analyses of forestry systems) – development of an 'analysis factory' where climate aspects have a great influence, and where new studies can be initiated (such as forest fuel harvest in young forests, thinning-free forestry).

> Climate change is a challenge facing us all, and is already a reality for many people in forestry. But Skogforsk is built for this type of challenge.

3 IMPORTANT CLIMATE SERVICES FROM SKOGFORSK

Forest tree breeding. The trees we are planting today will perhaps grow in an environment with a longer growing season, milder winters, and where there is a greater risk of damage by pathogens.

Skogforsk is testing improved trees in areas with both a warmer and a colder climate. In this way, plant breeding adapts the trees to new conditions faster than natural selection, which does not start until the climate actually changes.

Plant breeders also select the trees that are best adapted to different environments, so the trees and their seeds are better equipped to withstand changes over time. Plant breeding therefore prepares forests for an unknown future.

Less ground damage. Skogforsk is studying new technology (laser scanning and GIS analyses) and is testing new planning and felling methods to reduce ground damage. At the same time, machine operators, forest professionals and forest owners are being trained in the field and in RECO. Attitudes to ground damage are also monitored.

Lower use of resources. How do various driving methods affect fuel consumption? Skogforsk is analysing performance and costs of various operating systems under various conditions. This also has a link to reducing ground damage – less diesel is used when machines are operating on the ground rather than in it. Skogforsk is also leading projects in which larger haulage rigs are being tested, and is working with smarter, more environmentally sound logistics solutions.

What will happen if the pine wood nematode spreads to Sweden? In a warmer climate, a consequence could be that the pine would more or less disappear from parts of the country. Skogforsk has been commissioned by the Swedish Board of Agriculture to investigate how an attack could be resisted.

"Forestry could manage the logistics," says Gert Andersson, one of the editors of the report. "But would the operation succeed? It's not certain."

Text & photo: SVERKER JOHANSSON, bitzer@live.se

Are we well prepared?

The pine wood nematode is a roundworm, 0.5-1.0 mm long, that attacks and kills pines. In North America, the nematode is common, but there it has developed together with the host plants, which are resistant to attack. The nematode can spread in various ways – via infected wood (such as wood packaging), and by hitching a ride with the pine sawyer and its relatives (*Monochamus* spp). This is why import of coniferous tree plants and wood in the form of products, chips and wooden packaging is strictly regulated.

The risk of attack in Sweden has been analysed by the Swedish Board of Agriculture. The conclusion was that suitable host plants and the pine sawyer are here, but that the temperature is normally lower than that preferred by the pine wood nematode. However, an attack would result in 'dormant' infections and, in very warm summers, there is a clear risk of trees dying as in Portugal, where the nematode is found and control measures have been taken on occasions. Pine and larch are most receptive. Spruce is thought to be more resistant, but can still serve as a host plant.

Analysis of effects

Skogforsk has assessed the effects of a potential attack. The analysis was based on three hypothetical cases: Mönsterås, Uppsala and Strömsund. The assessment was carried out by a group of researchers with broad expertise in planning, logistics and forest conservation.

Gert Andersssson is head of the Planning research programme at Skogforsk.

"Mönsterås is an example of an area where the pine wood nematode could attack first," says Gert Andersson. "This is a region where summer temperatures can be high and there is a relatively high proportion of pine areas. And Mönsterås has industries that use large quantities of wood, including imported wood."

Site of infection: Uppsala | Cost: SEK 1 000 000 000 | Success rate: ?

Uppsala is another example: an area with a relatively high population density and much forest land close to built-up areas.

The greatest risk of the pine wood nematode being introduced to Sweden comes from wooden packaging. The worm has been discovered on such packaging in Sweden, sent from Portugal.

"The strategy is to eliminate the pest by removing and treating all coniferous trees in an affected area or in an outer containment zone," explains Gert Andersson. "The wood will be burned, treated in the pulpwood process, or heat treated. Wood and logging residue may only be transported out of an area during the winter season.

"Based on what we've seen when major storms have hit, forestry can mobilise the necessary resources," says Gert Andersson. "But, yes it can be tough. The measures involve working in three shifts, every day of the week, as time is an important factor. This allows many hours of production, but a further 2-3 operators are needed per machine. It's a big practical problem, because there are not enough operators to mobilise regionally. It's probably easier to mobilise more machine teams, but that has an effect on the activities outside the region.

"Then all logging residue down to two cm must be removed;

The Uppsala case.

Eradication (red): the diameter of the area is 16 km. Containment (blue): The diameter of the contained area is 50 km, of which the outer 4 km is free of host trees – all coniferous trees must be removed in this area.

- All coniferous trees are felled from the edge of the area inwards.
- A 4-km zone at the edge of the area must be cleared of host trees before the next flying period of the pine sawyer starts (latest 31 March). Felling then continues inwards in the area.
- The wood is placed in quarantine.
- Stumps are cut low or removed.

- Logging residue thicker than two cm is collected.
- Cutover burning on ground where it is suitable.
- Deciduous trees are left.

The dense pine forest on the Uppdala Ridge from the 18th century will disappear when the coniferous trees in the core area must be removed.

6 CONCLUSIONS

- An attack could be met within existing forestry activities. Costs would increase in the form of more expensive felling, training, and greater administration in the form of control functions. Wood values are estimated to fall by about 15 percent. This applies to volumes up to approximately 5 million m^3 and a handling time of approximately 6 months.
- The total cost of operations and transports is estimated at approximately one billion SEK.
- When a containment zone is planned, natural tree-free areas (lakes, fields, etc) should be used as far as possible.
- In the event of an attack, a planning chain must be mobilised. The first decision concerns choice of control strategy with regard to geography, etc. Agencies, forestry companies, forest industries and energy companies must collaborate if the control measures are to be successful.
- The number of reception points should be minimised to ensure the highest possible quality in the handling chain.
- All parties involved must be trained.

perhaps cutover burning would be an effective way to handle it. Roads must be strengthened, wood piles covered, and wood and chips must be sealed during transport to heating plants or pulp mills," continues Gert Andersson. "So it's a real challenge, but we believe it's feasible.

"Our investigation only considered immediate measures, not the work that must be done during the years following an infection and decontamination. This includes removing self-generating coniferous plants for around 20 years in the case of eradication or, if an infected area has been contained, as long as the zone with no host plants is to be retained. Nor have we considered inoptimal and production losses caused by premature felling," says Gert Andersson.

Uncertain factors

"Then there are other factors that are difficult to assess. Would the operation succeed? Naturally, there's a big risk that the infection is not detected straight away. Has the nematode hitched a ride to new areas on the pine sawyers? And what would the general public think about large-scale eradication of coniferous trees?"

The supply chain as such is based on proven systems with known performance. But Gert Andersson and his colleagues are aware there are still a number of uncertain points:

- Felling of very young stands. Here, there is almost no experience of felling on such a large scale, and the work involved in removing every single plant/tree is hard to estimate.
- The meticulous removal of logging residues down to two cm. The costs and resources required can easily be underestimated.
- Elimination on ground other than forest land is difficult to review in terms of volumes and concentrations, as it is so heterogeneous. One challenge may be to gather sufficient volumes for chipping and transport away from the area. Harwarders would make the work easier.
- Quality management (covering, control, traceability, etc) is also unproven. Here, we anticipate a major task for the Swedish Board of Agriculture and companies to train people and ensure quality in the different aspects. Not least, it is important to ensure that no volumes go astray along the business supply chain.

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