

BEATING THE CHALLENGE OF PEATLAND TIMBER HARVESTING BY USING CONVENTIONAL MACHINES

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Background

The project got off the ground because of current needs. Due to intensive draining activity in the '60s and '70s, Finnish peatlands are now growing large volumes of timber, and increasingly so in the future. As a consequence of rising prices on Russian timber, efforts are being made to increase domestic harvesting, and peatland forests make up a significant source. With increased harvesting on peatlands, a larger number of the sites must be harvested on unfrozen soil. Simultaneously, due to ever-warmer winters, the exploitation of frozen ground in timber harvesting has also become increasingly complicated.

The purpose of the project is to look for practical solutions that can be used to increase timber harvesting in unfrozen peatland forests by exploiting commonly-used machines.

The development target areas are 1) equipping forest machines for soft terrain, 2) adapting working routines to soft terrain, 3) improving planning (site selection, site planning, timing) and 4) improving the capabilities of timber harvesting companies with regard to peatland operations.

The project was a joint project between Metsähallitus, Ponsse Oyj and the Finnish Forest Research Institute. The tracks tested were supplied by Metsätyö Oy, who also supplied the track expertise necessary for the project. An MSc thesis is being prepared for the University of Joensuu on predictions of peat soil carrying capacity.

Expanding the usage area of conventional machines: a reasonable policy

The poor carrying capacity of the soil is a problem in timber harvesting on unfrozen peatland. The machine options are to rely on special machines (cf. dedicated track vehicles) or to try and improve the possibilities of using regular harvesting equipment. However, it is a fact that the use of machines designed for soft-ground conditions is expensive. Moreover, it is probably not wise to separate peatland operations from other harvesting activities either. So, with regard to development, it is reasonable to start by expanding the area of use of regular machines. Later on, in pace with the development of the contracting industry, special machines for peatland harvesting may evolve.

Referring to the project results, there is no immediate need to wait for dedicated track vehicles or other special machines. It is possible with wide, appropriately-designed tracks to significantly improve the capacity of regular forwarders on unfrozen peatland. Widening the tracks also widens the machine but not, however, excessively, with respect to damage to standing trees. The auxiliary wheel solution developed in the project enables use of regular forwarders on very soft terrain without causing excessively deep ruts or getting stuck. The concept can be further developed.

Improvement of harvesting conditions and work adaptation

It is probably not wise to try to develop machines that manage every peatland condition. It is essential to realise that on peatlands, there are always some critical spots that make the operations fail. Consequently, improvement of the harvesting conditions and work adaptation is a good idea. There are a number of solutions available: marking off soft areas, location of piles and strip roads, optimisation of load size and strip road passes, measures for ground strengthening etc. The solutions include various scheduling-based measures; for instance, utilisation of dry periods and time-escalated activities (two step harvesting). This method is cheap, but neither is the development and use of special machines.

Strengthening of the ground as a means to reduce rutting has had very little attention in Finland. There are a number of solutions available: reinforcing the soil with cutting debris or pulpwood, using transferable duckboards, evading of soft spots, and utilisation of various transferable bridge constructions. With regard to an attitude change, training is a key ingredient. There is a definite need for a comprehensive training package for peatland operations.

Classification of machines and conditions a prerequisite for increased operations on peatlands

Development of a classification scheme for forest machines and harvesting conditions is an inevitable measure, if harvesting on unfrozen peatland is to be significantly increased. The classification covers planning and enforcement of harvesting operations, as well as facilitates contracting. Development of a scheme is also important with regard to machine development. The scheme may also support timber trade. Development of a scheme is a challenge, but to get going the project developed a wireframe model to start with.

The classification scheme is proposed to be further developed in a number of pilot trials before any nationwide implementation. Classification of machines and sites has been discussed for a long time, and hopefully practical trials based on the outlined scheme result in something tangible.

The quality requirements for peatland harvesting must be revised

The harvesting quality requirements cannot be the same for peatland as for mineral soil forests. The most efficient way to prevent harvesting on unfrozen peatland from becoming a prevalent practice is to set quality requirements that cannot be fulfilled in real life operations. It is not necessarily a question of applying looser requirements on peatlands than elsewhere; it is more about taking the special requirements and realities of peatland harvesting into consideration. A purpose-equipped machine may need a wider strip road in the bends than normally used and it may be impossible to reach the same level with regard to rutting, as on mineral forest soil. Correspondingly, you can include preventive actions in the instructions as, for instance, ground reinforcing requirements.

Based on the results the project gives a number of recommendations, some of which can be enforced immediately. Recommendations that need joint input from all parties involved are

1) testing and further development of the outlined peatland and machine classification scheme, 2) planning and enforcement of a peatland harvesting training course for contractors and operators and 3) revising the harvesting quality requirements and adaptation of recommendations. Enforcement of the recommendations requires a coordinating body accepted by all parties.

Figures:

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Figure 1. The auxiliary wheel solution developed in the project. The original idea was to mount the auxiliary wheels in front of the rear bogie, close to the articulation joint. Due to limited space and a strict project schedule the auxiliary wheels were attached to a detachable frame behind the rear bogie. A simple but working solution that fulfills the requirements of being an accessory. (Photo Sami Lamminen)

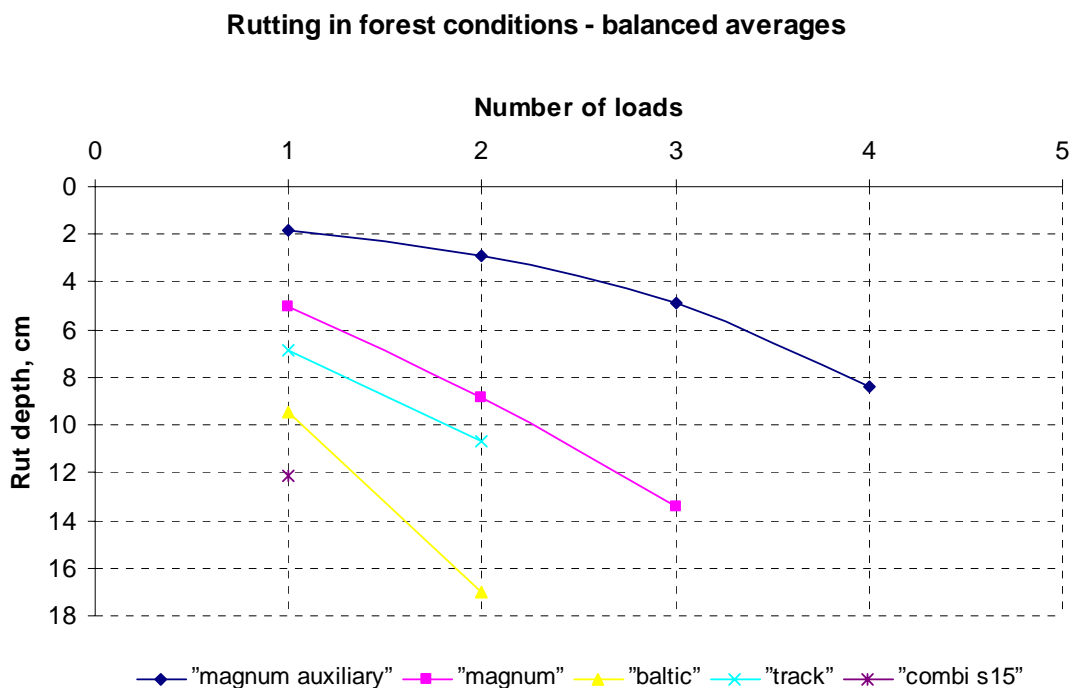


Figure 2. Rut depth on the forest block. The tested configurations were a Ponsse Wisent forwarder with Eco Magnum tracks and auxiliary wheels (track width 916 mm front/1023 mm rear), with Eco Magnum tracks (916 mm/1023 mm), with Eco Baltic tracks (850 mm/850 mm) and with Eco Tracks (chains/850 mm). Finally, an old Ponsse S15 was equipped with Combination Tracks (chains/790 mm) for comparison.

Rutting in field conditions - balanced averages

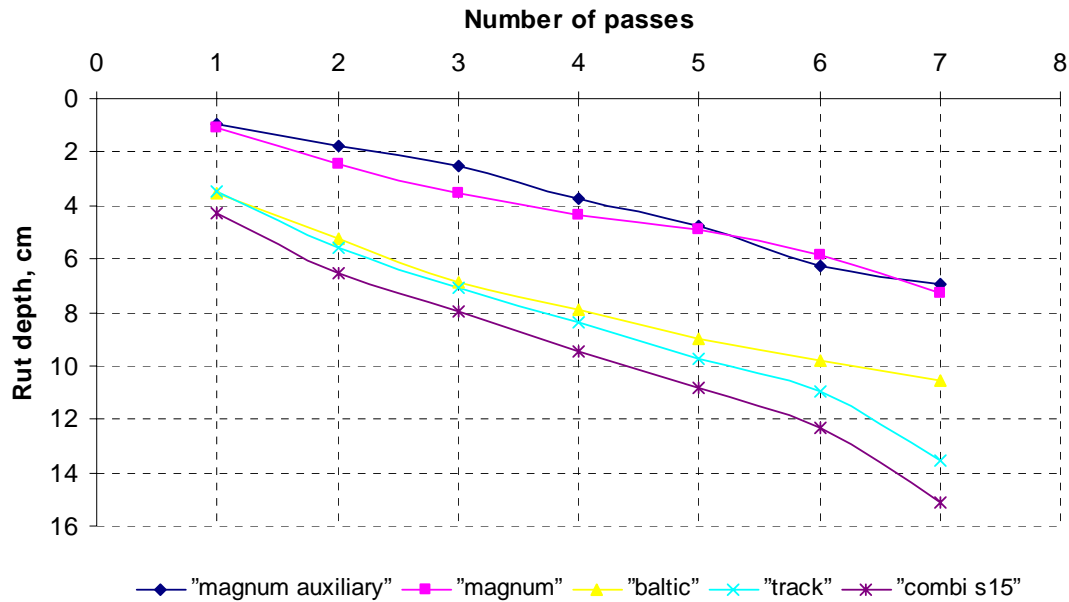


Figure 3. Rut depth on the field block. In homogenous field conditions even small differences can be observed. On the field block rutting was just moderate when using wide tracks so the machine did not gain much benefit from having a larger bearing area, achieved by using auxiliary wheels.

Level of peatland capability	Eight-wheel forwarders	Six-wheel forwarders
Increased flotation	Maximum avg. ground pressure 50 kPa, load size 8 tonne Equipment examples: <ul style="list-style-type: none"> • 12 tonne machine: front chains and rear tracks, width 700+ mm • 17 tonne machine: front and rear tracks, width 700+ mm 	Maximum avg. ground pressure 50 kPa, load size 8 tonne Equipment examples: <ul style="list-style-type: none"> • 12 tonne machine: front tracks with auxiliary wheels and rear tracks, width 700+ mm • 17 tonne machine: front tracks with auxiliary wheels and rear tracks, width 760+ mm
High flotation	Maximum avg. ground pressure 40 kPa, load size 8 tonne Equipment examples: <ul style="list-style-type: none"> • 12 tonne machine: front chains and rear tracks, width 750+ mm • 17 tonne machine: front and rear tracks, width 	Maximum avg. ground pressure 40 kPa, load size 8 tonne Equipment examples: <ul style="list-style-type: none"> • 12 tonne machine: front tracks with auxiliary wheels and rear tracks, width 820+ mm • 17 tonne machine: front tracks with auxiliary

	870+ mm	wheels and rear tracks, width 970+ mm
Extreme flotation	<p>Maximum avg. ground pressure 30 kPa, load size 8 tonne</p> <p>Equipment examples:</p> <ul style="list-style-type: none"> • 12 tonne machine: front tracks and rear tracks with auxiliary wheels, width 700+ mm • 17 tonne machine: front tracks and rear tracks with auxiliary wheels, width 820+ mm 	<p>Maximum avg. ground pressure 30 kPa, load size 8 tonne</p> <p>Equipment examples:</p> <ul style="list-style-type: none"> • 12 tonne machine: front tracks with auxiliary wheels and rear tracks with auxiliary wheels, width 730+ mm • 17 tonne machine: front tracks with auxiliary wheels and rear tracks with auxiliary wheels, width 850+ mm
<p>Corrections:</p> <ul style="list-style-type: none"> • If the weight of the unloaded machine without tracks is less than 12 tonnes, the level is one class better • For similarly-equipped harvesters, the capability level is one class better (only to be used in connection with separate cutting) 		

Figure 4. The project outlined a scheme for classification of machines and peatland stands. The figure demonstrates the proposed classification scheme for regular machines. The ground pressure minimums can be achieved by other means than those described in the scheme. The scheme is a draft that must be adapted to its purpose by experience from pilot trials.

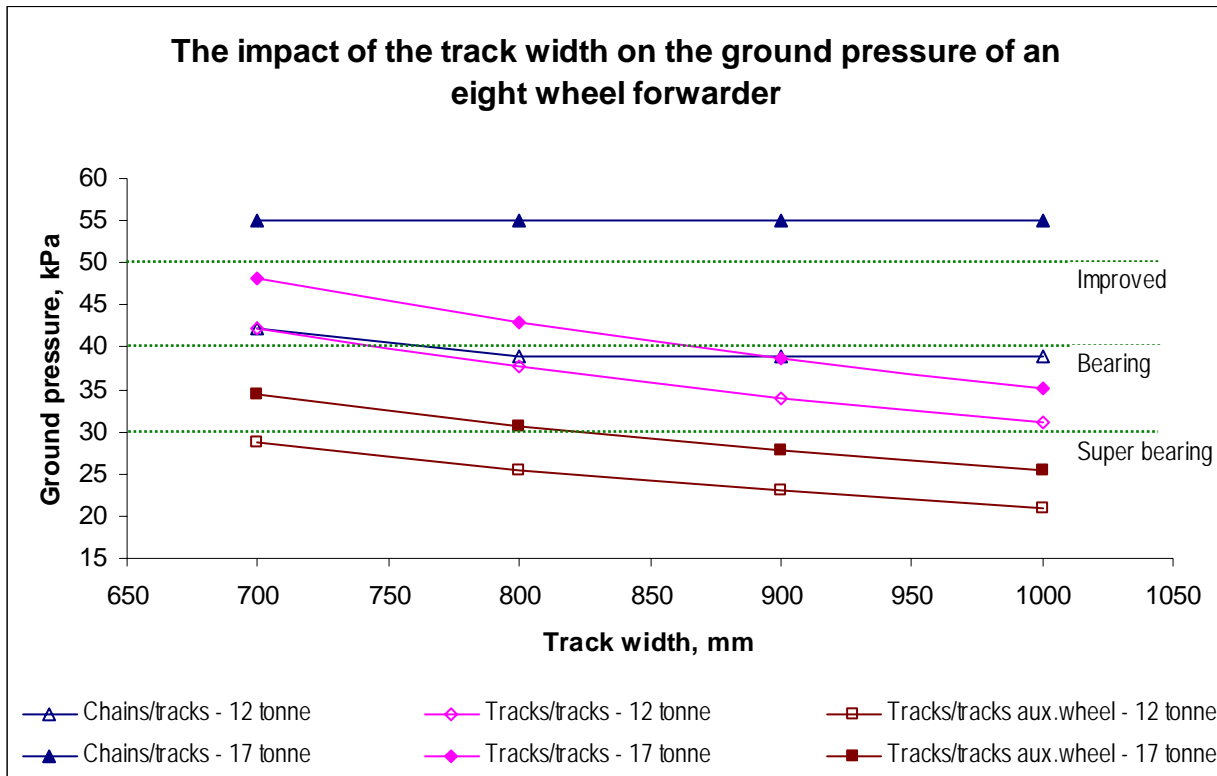


Figure 5. The examples for different machine classes were calculated by widening the tracks for three base-equipment alternatives and two machine weight classes. The curves in the figure are for an eight-wheel forwarder.

Trafficability class	Directive total timber volume of the peatland compartment, m ³ /ha	Minimum peatland capability level
0	- 220	Standard
1	220 - 170	Increased flotation
2	170 - 120	High flotation
3	120 -	Extreme flotation

Corrections:

- If significant surface wetness is observed (groundwater level less than 25 cm from the surface of the bog), the trafficability class lowered by one class
- Other factors that are expected to affect the trafficability class can be considered in the classification (for instance condition of ditches, tree species distribution, dwarf shrubs/grasses)
- In clear-cuttings the classes must be adapted to prevailing conditions
- If harvesting is preceded by a dry period of 1.5 months or longer, the pre-evaluated trafficability class should be raised by one
- The classification assumes that heavily-loaded and/or small-sized weak spots on the strip roads are duly reinforced (cutting debris, pulpwood beds, transferable duckboards, transferable bridge constructions etc.) or that critical places can be managed by other means such as good planning or driving technique

Figure 6. The peatland stand classification. The class limits will be adjusted to the right level based on pilot trial experiences. The trafficability class describes the condition in which an unfrozen winter harvesting stand can be harvested with machines of a given capability class. The trafficability class can be used as additional block information (3/2 = a winter block accessible in unfrozen conditions with mobile-level machines).

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Figure 7. There are a number of different solutions for peatland ground reinforcement. At the end of the '90s, transferable wooden duckboards were launched in Sweden (Markskonaren Alf). In 2000 Metsähallitus did comprehensive tests with transferable wooden duckboards, tyre mats and reinforcement with cutting debris. (Photo Kari Lassila)