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Benefits of remote controls and dual-drum winches for skidders in partial cuts

Abstract

FERIC assessed a cable skidder with a dual-drum winch and radio remote control in hardwood partial-cutting operations. Productivity increased by up to 32% depending on the technology used, and ground disturbance decreased by up to 40%. Trail occupancy and damage to residual trees also decreased (by up to 53% and 79%, respectively). Operators entered the machine significantly fewer times, thereby improving safety. Remote controls are cost-effective for any machine, but dual-drum winches are probably too costly to install on older machines.

Keywords:

Dual-drum winch, Remote control, Cable skidder, Productivity, Site disturbance, Safety.

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Introduction

Manual cut-and-skid operations are still common, particularly when working in small, scattered areas and where terrain makes machine travel difficult. Unfortunately, productivity suffers during partial cutting because machines must cover a greater area and operators must protect residual trees. To improve cable skidder productivity and reduce stand impacts, FERIC investigated the benefits of remote controls and dual-drum winches, which have been used in Europe for more than 20 years. Previous studies (Hamilton 1993, Hamilton 1997, Golsse 1999) revealed productivity gains, but did not formally address the other benefits such as reduced ground disturbance, damage to residual trees, trail occupancy, and operator entries into machines related to the use of dual drums and remote controls. The present

study documented these benefits, and the relative gains attributed to each technology.

Site and equipment description

Our studies occurred near Huntsville and North Bay (Ont.) in tolerant hardwood forests containing a minor softwood component. Pre-treatment basal area (BA) ranged from 27 to 35 m²/ha, with 425 to 730 stems/ha and an average DBH of 25 to 28 cm. Terrain varied, but was typically hilly, rough, and irregular, with some areas impassable. Soil bearing capacity was good outside lowlying areas, where poorly drained organic soils were typical. On hills, soils were thin, well-drained glacial tills overlying fragmented bedrock.

Westwind Forest Stewardship marked all study sites for individual tree selection



Note: The partial-cutting results from this study cannot be directly applied to clearcutting operations. Many of the issues (load accumulation, residual damage, and machine entries) only become problems during partial cutting. As such, one would expect less benefit in clearcutting.

to reduce BA by 8 to 12 m²/ha (i.e., 100 to 180 trees/ha marked for extraction). Some prescriptions thinned small stems to waste, particularly those species with low-density wood. To permit comparisons, the skidder was operated in the following modes: dual-drum or single-drum winch, with and without a remote.

The trial machine was a 130-kW (175-hp) 1998 Franklin C7F Maxi skidder that required minimal modification during installation of the dual-drum winch and remote control. The skidder's new fairlead and hydraulic butt plate could be raised and lowered to facilitate mainline and choker extraction and increase stability during winching. The winch (A.A.M. Bonier, Ambières-les-Vallées, France) was equipped with 40 m (per drum) of swaged 5/8-in. wire mainline with a 16-t line pull. The remote control (Falard Industrie, Saint-André-de-Corcy, France) had a 600-m range, and is worn on the operator's belt. Unique codes in the transmitter and receiver prevent interference from other units. Eight channels control engine stop and start, throttle acceleration and deceleration, and spooling of the two winch drums.

Productivity improvements

Table 1 presents the productivity improvements using the dual-drum winch and remote control during FERIC's studies. Adding a remote control to a single-drum winch or replacing it with a dual-drum winch plus a remote control increased pro-

ductivity by 17 and 32%, respectively. Dual-drum winches increase productivity (11%), but require a remote control to achieve their full potential.

Remote controls increase productivity by letting operators progressively choke and winch trees, and thus build loads more efficiently. Without them, operators return to the skidder and only begin winching once all felled trees that can be reached with the mainline have been choked. They must thus redirect the mainline back and forth to attach stems to either side, thereby reducing the number of stems that can be reached in each cable pullout. The resulting zigzag pattern also reduces mainline reach and life. Remote controls reduce the time spent on choking and winching, maximize mainline reach (i.e., the number of stems within reach), and minimize return trips to the skidder.

Cycle times increased by around 5% with a dual-drum winch and remote control, but load size increased by around 40%, for a net productivity increase of 32%. Using both drums maximizes load capacity during more skidding cycles because the load is collected using twice the length of mainline. Longer, smaller-diameter, lighter mainlines can also be used with dual-drum winches because each line carries less load than a single cable. Operators can reach farther into the stand and access more trees.

Remote controls also let operators help fellers when trees hang up during felling or when a tree settles onto the chainsaw bar. Moving the tree is difficult without a remote control because the skidder opera-

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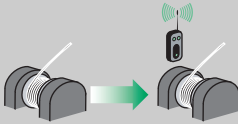
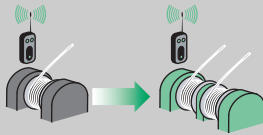
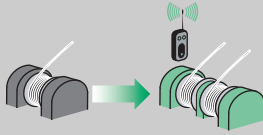
tor must work from the cab and listen for the feller's instructions. A remote control lets the operator stand at a safe distance (but within view of the work site) and precisely control winching. The lower winching speeds and the gradual accumulation of loads should decrease wear and tear on the skidder and decrease mainline and choker breakage, as well as fuel consumption. Workers reported less fatigue due to the more even, relaxed pace, and the increased cooperation and sharing of work. This was particularly true in winter use of remote controls. During winching, the operator can follow behind the load in the trail cleared by the tree stems rather than having to wade through unbroken snow.

Reduced machine entries and exits

Entering and leaving the skidder less often significantly improves safety, since both are primary sources of injury and also increase fatigue. In the forest, entries and exits arise mostly when winching choked trees and repositioning the skidder to reach the next winching corridor. The remote control reduced entries and exits by more than 80% (Table 1).

At the landing, entries and exits (primarily to raise and drop the load to break it apart and provide access to chokers) also decrease, mainly due to the remote control. With smaller machines, operators can often access the winch lever while standing between the skidder's front and rear wheels, but this is risky because the operator can be crushed if the brakes fail. Remote controls let the operator work from a safe distance, eliminate the need to manually free chokers or mainlines jammed between trees, and often necessitate only a single entry at the landing—to reenter the cab and return to the harvest block.

Table 1. Productivity improvements and reduction in the number of entries into the machine with a remote control and a dual-drum winch

	Productivity (m ³ /PMH)	Entries into the machine (%)	
		In the woods	At the landing
	+17%	-83	-35
	+11%	0	-10
	+32%	-83	-41

Environmental impacts

Dual-drum winches and remote controls can help significantly reduce mineral-soil exposure, occupancy of the site by trails, and damage to residual trees on skidding operations (Table 2).

Ground disturbance

Mineral-soil exposure occurs primarily on extraction trails, and sometimes along winching corridors (mostly on uneven sites). Dual-drum winches and remote controls reduced this disturbance by about 30 and 15%, respectively, mostly due to the reduced trail occupancy. Remote controls also permit more careful winching and more gradual building of the load, which can both reduce soil disturbance.



Note: The environmental benefits reported were made possible by the remote control and dual-drum winch, but attaining them requires well-trained, motivated workers.

Trail occupancy

Trail occupancy is a concern because skid trails are closely associated with mineral-soil exposure, soil compaction, damage to residual trees, and reduction of the productive landbase. Remote controls with single-drum winches reduced trail occupancy by about 10% by decreasing the length of secondary trails without changing trail spacing. Remote controls let operators build loads more gradually, so that bringing stems into the main winching path requires less power and reduces movement of the skidder into the stand. Dual-drum winches and remote controls together reduced the area occupied by trails by over 50% by increasing usable mainline length, thereby increasing trail spacing.

Damage to residual trees

Remote controls reduced damage to residual trees by 75%, largely by permit-

ting more careful winching. With a remote control, the operator can avoid damaging trees by resetting chokers, redirecting the mainline around stumps, or wrapping the choker around stems. Working close to the load with the remote lets operators anticipate and prevent damage with little effect on productivity. Operators also report reduced choker breakage because they could prevent loads from hanging up on stumps and other obstacles.

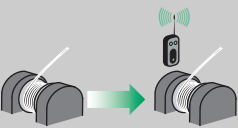
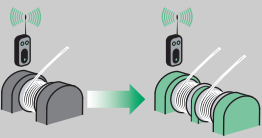
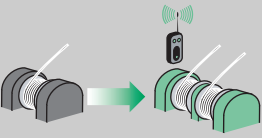
Damage reduction also results from reduced trail occupancy, since trails are high-risk regions. By increasing trail spacing, dual-drum winches also contribute to reducing damage. As well, they permit extraction of smaller loads from each winching corridor, further reducing damage.

Implementation

Remote controls for a single-drum winch cost \$4500 to \$8500, including installation, depending on the skidder. Skidders with electric-over-hydraulic winch controls have lower installation costs than older models. A dual-drum winch with a hydraulic butt plate costs around \$50 000, but may not fit all skidders because of the winch dimensions. Remote controls and dual-drum winches must be custom-fit to each skidder. You can calculate the payback time for a remote control or a dual-drum winch using Worksheet 1.

For example, a logger with a single-drum winch might produce 50 t/day and earn \$600/day at a pay rate of \$12/t. Adding a remote control to gain a 15% productivity increase would increase income by $(0.15 \times \$600) = \$90/\text{day}$. If the installation costs \$5000, working 56 days $(\$5000/\$90)$ would repay the investment. This estimate excludes financing costs and variables such as the time required to learn to take full advantage of the new tool. A dual-drum winch with a remote control would cost more, and would take longer to repay. With the same initial production and pay rate, a 30% productiv-

Table 2. Reduction in environmental impacts with a remote control and a dual-drum winch

	Ground disturbance (% mineral-soil exposure)	Occupancy of site by trails (%)	Damage to residual trees (%)
	-13	-9	-75
	-31	-49	-20
	-40	-53	-79

WORKSHEET 1	Amount	Result
1. Enter your daily productivity without a remote control or dual-drum winch:	_____ (unit of volume, e.g. m ³)	
2. Multiply the amount in line 1 by your pay rate:	_____ (\$/unit volume, e.g. \$/m ³)	
3. Multiply the result in line 2 by the expected increase in productivity: Note: For a remote control, the maximum value should be 0.17 (a 17% increase); for a dual-drum winch plus a remote control, the maximum should be 0.32 (a 32% increase).	_____ % increase expressed as a decimal (e.g., 20% → 0.20)	
4. Divide the total cost of the modification by the result in line 3 to get the payback time:	Cost: \$ _____	_____ days

ity gain would increase earnings by $(0.30 \times \$600) = \$180/\text{day}$. If the installation cost \$50 000, the logger would work approximately 280 days $(\$50\ 000/\$180)$ to repay the investment.

Remote controls can be added to most current skidders, and offer a cost-effective way to increase productivity and reduce the strain on both worker and machine. Dual-drum winches offer similar benefits, particularly when paired with remote controls, but cost more and may be impractical for older machines near the end of their working life; they make the most economic sense when purchased as an option on new skidders. If working in larger timber, the addition of a dual-drum winch only makes sense on larger skidders, so as to take advantage of the potential to increase load size. A dual drum should only be mounted on smaller skidders when they're working in small wood. Wherever a skidder has difficulty achieving its maximum load, both technologies will improve productivity. Conscientious operators can

use both technologies to significantly reduce trail occupancy, damage to residual trees, and mineral-soil exposure.

If you choose to implement the use of a remote control or dual-drum winch in your operations, the skidder operator will be working outside the cab during certain phases of the operation, and will thus be unable to benefit from the skidder's protective cab. Pay close attention to the manufacturer's safety instructions and provincial worker safety regulations when planning your operations. To help you create a safer work environment, we've also included a list of recommended safe working practices in Appendix 1.

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Current costs and additional information can be obtained from:

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Appendix 1.

Recommended safe operating practices for users of remote controls and dual-drum winches

These guidelines are for skidder operators using remote controls to activate a skidder's winch and throttle. The practices described in this guide are only intended to supplement the safe operating practices required by your employer, your provincial Department of Labor, and other worker safety organizations. Although we have tried to ensure that these procedures are complete, it is never possible to identify all potentially dangerous practices. Operators of remote-controlled winches must take full responsibility for evaluating the work environment and must take all possible precautions to ensure their safety and that of their co-workers during all phases of the work.

General precautions

Workers using remote-control winches generally follow the wood being winched back to the skidder, and are no longer protected by the machine's cab during winching. Pay careful attention to avoid tripping over stumps, walking into sharp branches, being struck by dead standing trees knocked over by the moving load, and other hazards.

Because you can't feel how the skidder reacts to the stresses of winching, pay close attention to the load's behavior and keep an eye on the skidder if possible; for example, watch for loads hanging up on stumps, skidder movement, and other potential hazards to yourself and others. If a load suddenly hangs up during winching, the load may swing rapidly and violently to either side of the skid trail. Make sure you are not standing at a vulnerable location.

Regularly test all the remote control's safety features to ensure that they remain in good working order. These features may include but are not limited to a warning horn, strobe light, or rear cab light. In addition, the skidder's parking brake must always be in working order and must be engaged during winching.

As remote controls are new to North American operations, we ask any interested individuals to send us comments and suggestions concerning safe operating practices for remote-controlled skidders to the author (peter-h@mtl.feric.ca).

Specific practices

1. Before winching, secure the skidder in a safe location. The skidder should be on flat ground to minimize the potential for a rollover. If you must work on slopes, position the skidder so the fairlead is aligned up or down the slope rather than across the slope. Lower the skidder's front blade and apply the parking brake for additional stability.
2. Position the skidder so the fairlead, machine, and mainline form a straight line. Avoid winching at angles that require the mainline to contact the fairlead's side rollers.
3. After setting one or more chokers, and before activating the winch, step back a safe distance so you are clear of the load, but can still monitor the load's progress and the skidder's stability.
4. Ensure that everyone in the work area is clear of the load and outside the "danger triangle" (Figure 1). Start winching only once this area is clear and winching poses no danger to anyone.
5. As you return to the skidder, follow *behind* the load. Never walk alongside a load, where you can be struck if the mainline breaks or the load shifts. On a slope, walk behind and slightly to the uphill side of the load.
6. At the landing and when using the remote control to break chokers free from the load, everyone present must stand back a safe distance. This distance depends on the length of the chokers and their position within the load, and must be determined on a case by case basis.
7. **Never** operate the remote controls while standing on the skidder, between its wheels, or in close proximity to the skidder. Unexpected movement of the machine during winching could cause serious injury.

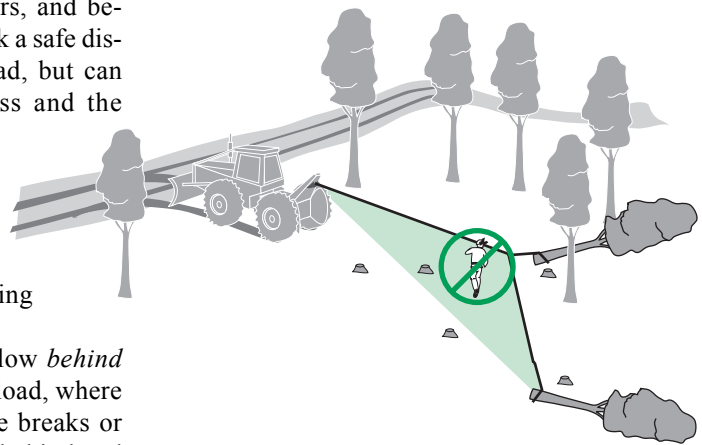


Figure 1. The skidding "danger triangle".