HARVESTING IN DIFFICULT TERRAIN

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INTRODUCTION

Formerly, papers discussing harvesting in difficult terrain could deal solely with the development of logging systems for areas economically inaccessible to the "conventional" logging systems. Now, however, the term difficult has expanded to include visual, wildlife, social and other concerns. The ability to harvest an area at a profit has, almost, become secondary. The question is not "Can we log this area at break even or at a profit?" rather it is becoming "Will we be able to log this area at all?". Table 1 (Lynn 1992) illustrates this phenomena for the old-growth forests of the Western United States. Traditionally government lands in the five western states (California, Oregon, Washington, Idaho and Montana) have provided 50% of the fibre supply for the area's timber processing plants. The success of the preservationists in enacting policies for setting aside old growth timber and, more recently, preserving wildlife habitat has had a significant impact on these plants' abilities to provide product and employment. Similar situations exist throughout North America. Treat all harvesting areas as difficult and proceed accordingly, appears to be the best advice for loggers and timber managers. The challenge is to effectively and profitably undertake all phases of timber management, from initial planning through harvesting, stand re-establishment and tending.

Table 1. Timber Sales Have Reduced Dramatically

WESTERN GOVERNMENT TIMBER SALES
(million bd ft)

Selling Authority	FY1987	FY1988	FY1989	FY1990	FY1991	Target* FY1992
U.S. Forest Service:						
Region 6 (West)	3,359	3,187	1,123	3,791	171	1,150
Region 6 (East)	1,648	1,560	1,323	1,594	709	1,150
Total Region 6 (Oregon, Washington)	5,007	4,747	2,446	5,385	880	2,300
Region 5 (California)	1,400	1,626	920	1,102	520	500
Region 1 (Idaho, Montana)	873	800	749	591	540	600
Total Western USFS	7,280	7,173	4,115	7,078	1,940	3,400
BLM[1] - Oregon (federal)	1,148	976	711	1,131	489	750
OSDF[2] - Oregon (state)	160	174	158	117	119	150
DNR[3] - Washington (state)	870	837	803	835	571	600
Total Western government	9,458	9,160	5,787	9,161	3,119	4,900

1 - Bureau of Land Management
2 - Oregon State Dept. of Forestry
3 - Dept. of Natural Resources
Source: Timber Data Co., National Forest Products Assn.
* Target not likely to be met

CHANGING PUBLIC OPINION?

Increasingly, the decision to harvest timber is becoming politically rather than practically/scientifically based. As Les Reed stated at the conference "Wood Product Demand and the Environment" held in Vancouver (November, 1991), "It seems that facts count for less, while personal choices and philosophic preferences count for more". Despite a barrage of public education, forest management appears a mystery to most of the general public. In the latter months of 1991, 2,513 Canadians were interviewed on issues relating to forestry in Canada (Forestry Canada 1992). The poll provided an opportunity to compare responses with those of a similar 1989 study. The results indicated that the natural environment is one of the top three things which Canadians think makes Canada unique. In British Columbia (B.C.) 20% specifically mentioned forests or the loss of forests as their greatest environmental concern. Overcutting and clearcutting rose to the top of the list for perceived threats to the forest (up from 20% to 37% overall: 52% in B.C.). (A 1991 survey of B.C. Professional Foresters endorsed clearcutting.) It is interesting that even in a time when the forest companies were deep in red ink, most Canadians thought the forest industry was very (20%) or somewhat (50%) profitable. It is clear that the debate on forest management will continue and will occur far from the logging site at issue. The ultimate limit to preservation appears to be the prosperity of the society. A bolt of enlightenment cannot be expected.

WHAT'S A LOGGER TO DO?

Given that suitable "political" approval has been secured, it is up to the logger to employ systems and methods to meet the social and economical objectives. For coastal B.C. four yarding methods: helicopter, balloon, skyline and shovel logging (hoe chucking), have evolved to deal with the challenges of exceptional terrain. Reduced road access and density (less environmental impact, lower road construction cost) and a requirement to harvest a representative "profile" of a forest licence have been the major impetus for the application of helicopter and skyline yarding. Shovel logging has emerged as a viable alternative to ground skidding systems.

HELICOPTER YARDING

The use of helicopters for yarding timber is not new, with the first reported testing in Scotland (Shaw 1959). In the 70's helicopter logging became a commercial reality in both Canada and the United States. Then, as now, the interest was spurred by environmental concerns and the need to increase fibre supply from areas which could not, economically, support the road network required for conventional cable yarding systems. The cost of operation for these systems, however, limits their use to yarding high valued timber and makes them sensitive to the rise and fall of log values. In 1992, the three major helicopter yarding operators plan to yard approximately 600,000 cubic meters of wood or 2.4% of the total coastal B.C. harvest.

Advantages for helicopter yarding include (Zimmerman 1991):

- Access timber considered inaccessible to conventional systems
- Negligible impact on ground and advanced re-growth stimulates rapid site green up and maintains integrity of the site

- Irregular boundaries allow visual integration with surrounding landscape and increased edge area for wildlife
- Quick response to market opportunities, selectivity of logging sites
- Ability to water drop logs to minimize cycle time and enlarge system flexibility.

Disadvantages include:

- Weight limitations may require tradeoffs between bucking for grade and bucking for payload weight
- Vulnerable to adverse weather
- Special manpower skills required
- Greater accident severity potential
- Higher post-logging access costs
- No site scarification
- High uptime required to maintain acceptable costs.

Machines of choice include: Sikorsky Models S-64E(9,090 kg payload) and 61L (3,864 kg payload) and Boeing Vertol Model 107 (3,636 kg payload). HELIFOR, the largest helicopter yarding operator in B.C., is budgeting approximately 220,000 cubic meters of production for its one Boeing Vertol and has plans to add a second machine later this year to yard an additional 100,000 cubic meters. All of the machines come to logging after fulfilling other civilian or military duties - logging cannot support the purchase cost of a new or purpose built machine. Of recent interest is the Russian Kamov Ka-32 helicopter. Its unique piggy-backed counter-rotating rotors (three blades per rotor) negates the need for a tail rotor. Designed primarily for sling loads, the machine has a payload capacity is 5,000 - 5,900 kg. During a test operation for Vancouver Island Helicopter (VIH) at Gordon River B.C., the machine averaged 800 cubic meters per shift and appeared to operate successfully removing 35,000 cubic meters (Doyle 1992). Longterm utilization of the machine will depend upon certification in Canada (being pursued by VIH). If the Kamov Ka-32 proves to be an acceptable logging machine it may represent a significant opportunity to the forest industry.

BALLOON

The one balloon operation currently operating in B.C. yards approximately 55,000 - 60,000 cubic meters annually. Daily production averages approximately 250 cubic meters per shift, with yarding distances of 850 - 900 meters. Operated by Skyhook Enterprises Ltd., of Campbell River B.C. the system utilizes a natural shaped, helium filled balloon displacing approximately 15,000 cubic meters; net lifting capacity is approximately 7,270 kg. Two Washington 608A inter-locked double drum winches are used to yard the turn and haul back the balloon. Due to mechanical complexity and maintenance problems, the interlocks have been disconnected and only one winch is used per machine. The yarders work against each other with one braking the other throughout the yarding cycle. The advantages/disadvantages for the system include those associated with helicopters plus a reduced cost of operation compared to helicopters. Wind, fog and snow are a concern with the system, however, these did not prove to be a factor during 1991. MacMillan Bloedel's Stillwater Division plans to budget 20,000 cubic meters annually for this system in 1993 and 1994.

SKYLINE

Skyline systems are enjoying a re-birth as operators adapt these systems to the needs of the 1990s. Although widely used in the United States, skyline systems gave way in Canada during the 1970s and 80s to the more productive grapple yarding system

(grapple yarding is still the most prevalent yarding system on the coast). The need to reach farther, reduce the density of roads and harvest the terrain profile made loggers look to the past and incorporate some of the developments of the United States loggers. Operators see skylines as the least expensive alternative when total timber accessibility is required.

A review of skyline systems (Doyle 1991) identified 17 skyline systems operating in Coastal B.C.. Yarder models included Thunderbird, Madill, Washington and Skagit. The survey noted that most of the machines were second hand and, due to the timber cut reductions, an ample supply of used machines would exist for some time in the United States. Carriage types varied as operators mixed and matched to accommodate specific timber/terrain requirements. Most common were Danebo/Thunderbird mechanical, and motorized models from Ross Corporation of Oregon. Other carriages included Golden Eagle, Ballenger and Bowman Mk II. Operationally the systems are reaching 600 - 1,200 meters. Reviving an old system has identified the need to teach and relearn old skills for both engineering the settings and operating the machinery.

Canadian Forest Products Experience

At the 49th Annual Truck Loggers Convention in Vancouver (1992), Walter Infanti of Canadian Forest Products presented some insights into their skyline operations. Skyline logging was initiated at Woss and Nimkish logging camps on Northern Vancouver Island following an inventory of remaining stands that identified 23% could/should not be yarded with conventional grapple or high-lead systems. Skylines were determined to be the least-cost alternative when compared to helicopters and balloons. The company purchased two used Washington 217D skyline yarders equipped with Bowman MkII self powered, radio controlled carriages. The choice of machine was dictated by the line diameter and length capacity necessary for the expected spans and payloads. Operational experience to January 1992 was:

- For 170 operating shifts; 86% operating, 9% moving and 5% non productive (includes mechanical downtime)
- Operating cost; $2792/shift compared to $1712 /shift for high-lead spar
- Yarding cost; $13.92/m^3 compared to $10.31/m^3 for high-lead spar
- Average span; 1,000 meters (maximum span 1,200 meters)
- Maximum yarding distance; 800 meters
- Target production levels; 250 - 300 m^3 per shift
- Development cost; approximately 50% that of conventional systems (13,500 m^3 of timber developed per km of road for conventional systems, 27,000 m^3 of timber developed per km of road for skyline.

An interesting safety point was the use of a strobe beacon on the machine's operator cab to warn low flying aircraft.

MacMillan Bloedel Experience

In the latter half of 1991, staff from the University of British Columbia, Faculty of Forestry, undertook a contract to collect and analyze production data for two Madill 046 skyline machines operating at MacMillan Bloedel's Franklin River Division on central Vancouver Island (McNeel, Howard & Young 1992). The objectives were to:

- Evaluate and compare the productivity of the J17 and J133 yarders configured as slackline skylines equipped with Ballenger hydraulic/mechanical carriages
- Evaluate possible improvements in operating procedures including:
  a) Use of electronically released chokers
  b) Variations in lateral yarding distances.

Average yarding distances ranged from approximately 200 - 250 meters (horizontal distance) with maximum yarding distances of over 400 meters. Pieces per cycle averaged 2.8 (J133) and 3.0 (J17). The major operational difference occurred in average piece size - 2.5 m^3 (J133) and 1.6 m^3 (J17).

Results and Conclusions

For both machines the choke and delay elements comprised the largest percentage of total time. Overall the J133 had a higher level of production primarily due to the larger piece size. The study pointed out that these machines, like helicopters, need to be loaded to their limit if peak productivity is to be achieved. Standardizing on a fixed number of chokers, regardless of piece size, leads to under utilization of machine capacity and increased cost. Other conclusions included:

- Carriage Maintenance; the need for continued preventative maintenance to maintain system uptime. During the study, carriage related problems accounted for 46% of the delay time. In many operations a spare carriage is on site to allow quick changeovers. However, the crew must be disciplined not to cannibalize the spare, thus making it also in-operable. The crew must be provided with spare parts, appropriate tools and trouble shooting guides. Whenever possible the mechanical systems should be standardized between carriages.

- Electronically Releasing Chokers (ERC); the added weight of the ERC made them difficult to accept and use by the chokersetters. Potential reductions in un-hook times were sufficient to recommend the development of strategies that would encourage their use.

- Optimal Yarding Road Width (OYR); for the observed setting conditions, OYR was estimated at 44 meters per road, far less then the 70 meters observed during the study. An opportunity exists, therefore, to reduce the work effort of the chokersetters while maintaining productivity by limiting the OYR.

- Planning; Engineering staff should be encouraged to work with the hooktender (skyline crew foreman) when developing settings as constraints and requirements differ considerably from those of grapple yarders. Coordination would benefit both groups and perhaps improve productivity through reduced road changes, fewer cable deflection problems and improved landing location.

More detailed reporting of the Franklin River Skyline project is expected during 1992 and 1993.

SHOVEL LOGGING

Shovel logging or hoe-chucking came to the B.C. coast via operations in coastal

Washington and Oregon. The system fulfilled the need for a highly productive yarding method for smaller mature or second growth timber on flat to gently sloping sites where, it was perceived, ground based skidding systems would have unacceptable environmental impact. Since the mid 1980s application of the system has grown. Over 9% of MacMillan Bloedel's non-contractor wood will be shovel logged in 1992. The availability of higher power-to-weight ratio and purpose built hydraulic log loaders has been one factor in the system's growth. Hydraulic machines currently utilized include Hitachi, Thunderbird, John Deere, Link Belt and Caterpillar. Operationally, the log loader traverses the setting (either parallel or perpendicular to the road depending on the setting design and terrain) swinging the wood from the back line to the road. Generally yarding distance is limited to approximately 135 meters or four to five swings of the machine. Setting slope is generally less than 20%.

MacMillan Bloedel Experience

At MacMillan Bloedel's Franklin River Division a Yutani MD400 hydraulic log loader has been applied to shovel log and load timber. Originally designed as an excavator the 184 kw machine was modified to meet the requirements of shovel logging. Modifications included (Sinclair 1990):

- addition of heavy duty guarding, larger fuel tank and counter weight and high-rise operator cab
- strengthened undercarriage and suspension; heavier upper track rollers and increased track tension
- boom pivot point (foot) moved back
- 14.5 meter Jewell live-heel boom and 360 degree rotation hydraulic Port Machine Works log grapple installed.

Gross machine weight is 59,000 kg with a lift capacity of 17,000 kg at 6 m. Shovel logging production ranges from 300 - 600 m^3 per 8 hour shift.

Although primarily used in a clear cut operation, shovel logging has been used successfully in partial and leave tree harvesting prescriptions. In June of 1992, MacMillan Bloedel will embark on a multi-year project to evaluate the impact of alternate silvicultural systems including: green tree selection (leave 25 stems per hectare), shelterwood (leave 30% of the volume) and patch logging (1 hectare clear cuts). All of the test areas will be logged with an hydraulic log loader. Production information will be gathered by the Forest Engineering Research Institute of Canada.

CONCLUSION

It is a forgone conclusion that the forest management debate will continue. Loggers, especially in areas of relatively high prosperity, will come under increasing scrutiny. Their challenge will be to meet environmental and social requirements while maintaining a positive economic margin. The development and application of suitable harvesting methods will require past techniques be revived and new ones tried. Throughout, the process will rely heavily on the loggers' initiative and inventiveness. Speedy and successful adaptation to the new rules may be the only means to survival.

ACKNOWLEDGEMENTS

The author acknowledges the assistance of Glen Young and Dr. Joe McNeel in the preparation of this paper. The financial assistance of the Logging Industry Research Organization of New Zealand to allow presentation of this paper is also appreciated.

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