SHOVEL LOGGING: COST EFFECTIVE SYSTEM GAINS GROUND

by

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ABSTRACT: Shovel logging was recognized as an effective logging system on gentle slopes of the Pacific Northwest in the mid 1970's. The high productivity and small crew size have made shovel logging a very cost effective system relative to other systems, ground-based and cable. Shovel logging, properly managed, causes little soil disturbance relative to other ground based systems. The combination of these two attributes make it an attractive system for timberland owners seeking to capture the greatest value from their managed forests while protecting the long term productivity of their lands. Shovel logging is increasingly being utilized on settings with more difficult terrain, previously considered "cable ground".

This paper provides an overview of shovel logging, equipment, specific techniques used on difficult terrain. A generalized view of relative costs and productivity experienced in Southwest Washington is presented. A Soil Management System that assures site productivity will be maintained is described.

KEY WORDS--Logging system, logging costs, soil disturbance, logging equipment

INTRODUCTION

There are three questions that commonly are asked concerning the topic of shovel logging at a mountain logging symposium:

1. Why should a mountain logging symposium be interested in a presentation on "shovel logging", a ground based system for moderate terrain?

2. How can a system employing an expensive piece of equipment with high

maintenance and operating cost; that requires the repeated handling of each piece be cost effective?

3. Does it cause excessive soil disturbance, and site degradation?

Simply stated, the answers to these questions are as follows:

1. Shovel logging is germane to mountain logging because the cost effectiveness of shovel logging is pushing its application to more difficult terrain.

2. Shovel logging is very productive; the production of a typical operation averages six loads/day with one machine and a two-man crew.

3. Shovel logging inherently has less impact on the site than other ground based systems.

These simple answers will be supported by discussion around the following topics:

- shovel logging equipment, origins, and application on gentle mountain slopes (<20%);
- specific techniques used to log moderate mountain slopes (20-40%); productivity and costs;

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equipment requirements; operator requirements; and environmental and silvicultural opportunities

ORIGINS

Shovel logging has been present since the mid 1970's in the Pacific Northwest. Initially the system was used on relatively gentle ground, most notably on the Olympic Peninsula of Washington State. Shovel logging refers to the use of a hydraulic excavator, modified and fitted with a grapple, as the principal means of yarding logs. The shovel systematically travels through the setting, swinging the logs closer to the road. The shovel travels unloaded. Log movement occurs as the stationary shovel picks up logs and, by rotating on the car body, swings the logs closer to the road

EQUIPMENT

Shovel logging equipment (as its name suggests) has its origin with hydraulic excavators. "Hoe chucking" is a term used in Canada. Hydraulic excavators are modified for shovel logging much as they are for log loading, with a logging boom, grapple, and cab riser. Some additional modification included heavier protection under the carbody, augmented fuel tank, and fire protection system. Several manufacturers now produce a "purpose built" machine for log loading and/or shovel logging. Other manufacturers customize their excavator to create their forestry equipment, or provide a base machine upon which others will do the "build up". The cost of these machines runs from about $320,000 to $360,000.

Medium size shovels (90,000 to 100,000 pounds machine weight) seem to be the most popular in second growth operations. Larger machines are seen more often in old growth settings. The boom lengths on six different configurations of medium sized machines ranged from 41 feet to 43 feet, with lift capacities at 40 feet ranging from about 11.2k to 16.9k. Another specification that showed wide variation was speed of the swing system, ranging from 8 rpm to 12 rpm. This slowest swing however could do it with 80 percent more power. The machines look a lot alike but have significantly different operating characteristics.

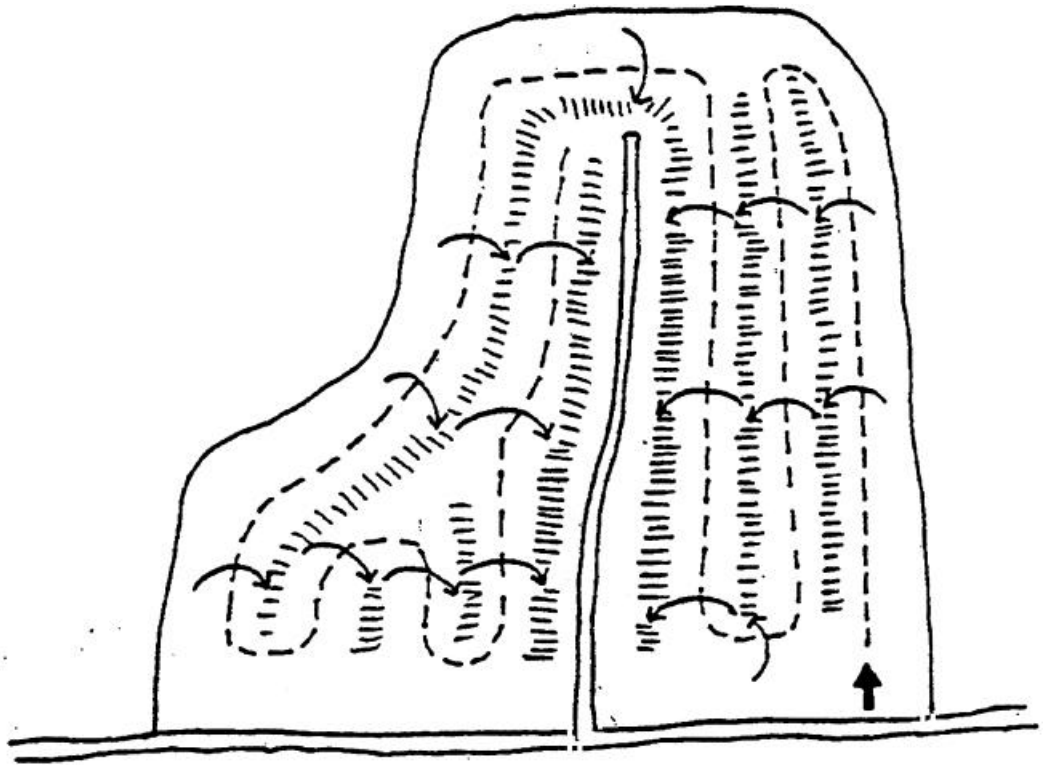

Figure 1. Serpentine yarding pattern

YARDING PATTERNS

On the gentle to moderate slopes less than thirty percent the shovel will methodically traverse an area, systematically swinging logs closer to the road. The shovel may follow a serpentine pattern that allows it to swing all the logs successively towards the road with a minimum of back tracking (Figure 1). Theoretically a shovel could swing all logs to the road while making one serpentine pass through a setting. The reality is that this occurrence is often precluded by the needs to refuel, maintain /repair shovel, or load trucks; all requiring a trip to the road.

TECHNIQUES ON MODERATE MOUNTAIN SLOPES

On more difficult terrain the operator is required to be more innovative. The terrain may include areas on which the shovel can not travel, precluding adherence to a serpentine pattern. On slopes up to 40% the shovel may work straight up or down the hill, swinging logs towards the road. This method affords greater machine stability and causes less soil disturbance than traveling sidehill. Starting nearest the road, the shovel clears a path and swings all logs within reach towards the road as he progresses away from the road. Upon reaching the back of the setting the operator will return on the cleared path, swinging all logs on either side

towards the road as he progresses. At the completion of one round trip to the back of the setting the operator has swung all logs within a 100 foot swath to the road. The shovel can either load trucks or move 100+ feet down the road and begin another yarding path to the back of the setting.

On terrain that limits machine travel the operator will seek accessible and stable positions from which he can operate. From these positions the operator can employ several techniques that effectively increased the range of the machine. One such method is to heel a log against the heel on the boom and use it as an extension. On steep (>40%) pitches that preclude equipment travel this extension could be slipped underneath a log above the machine, lift the log over a stump or whatever is holding it on the slope and allow it to roll down the heeled log. Likewise, when working below the machine the heeled log can be used to flip up one end of a log sending it further down the hill, toward navigable terrain and a lower road. Tongs can be attached to the end of the heeled log, perhaps doubling the potential reach. Machine stability is likely to limit this technique in large timber. Another method used to good effect on steep ground is to place a couple of logs perpendicular to the slope contours and to roll logs down them, towards a road below. Skilled and experienced operators have safely employed these practices.

The addition of a single free spooling drum to the boom offers the opportunity to ground lead yard small areas not navigable with the machine. Other modifications that provide cable ability include a “tong tosser” and the addition of two drums providing highlead capability.

PRODUCTIVITY AND COSTS

The actual unit cost experienced for shovel logging has been 40 % less than that with some cable alternatives. This large difference in cost effectiveness has pushed the application of shovel logging to some sites previously considered “cable ground”. Certainly there are sites that will never be considered appropriate for ground based systems. There are sites however; that although they present a challenge to ground based operators can be effectively and safely logged with a shovel at a much lower cost.

The relative costs presented here are not empirically derived. They are actual costs experienced over the last three years by contract loggers who each own and operate both cable and shovel sides. The settings include both gentle and moderate slopes, some with steep pitches. Typically, there is mixed terrain on a given setting. The average external yarding distances for the shovel-logged settings is about 600 feet. The timber, all second growth, averaged about 70 ccf/acre (30 mbf/acre) with a piece size of 0.23 cunits (100 bd. ft.).

Figure 2 presents relative logging costs for both a slackline tower and a swing yarder operating in the same region for comparative purposes. Many of the settings the tower and swing yarder operated on were not suitable for shovel logging (too steep or sensitive) and had longer external yarding distances. Average external yarding distance for the cable systems was about 800 feet. Acknowledging these differences, the comparison is valid in illustrating the magnitude of potential savings.

What do these opportunities look like?

- Slopes generally less than 40%

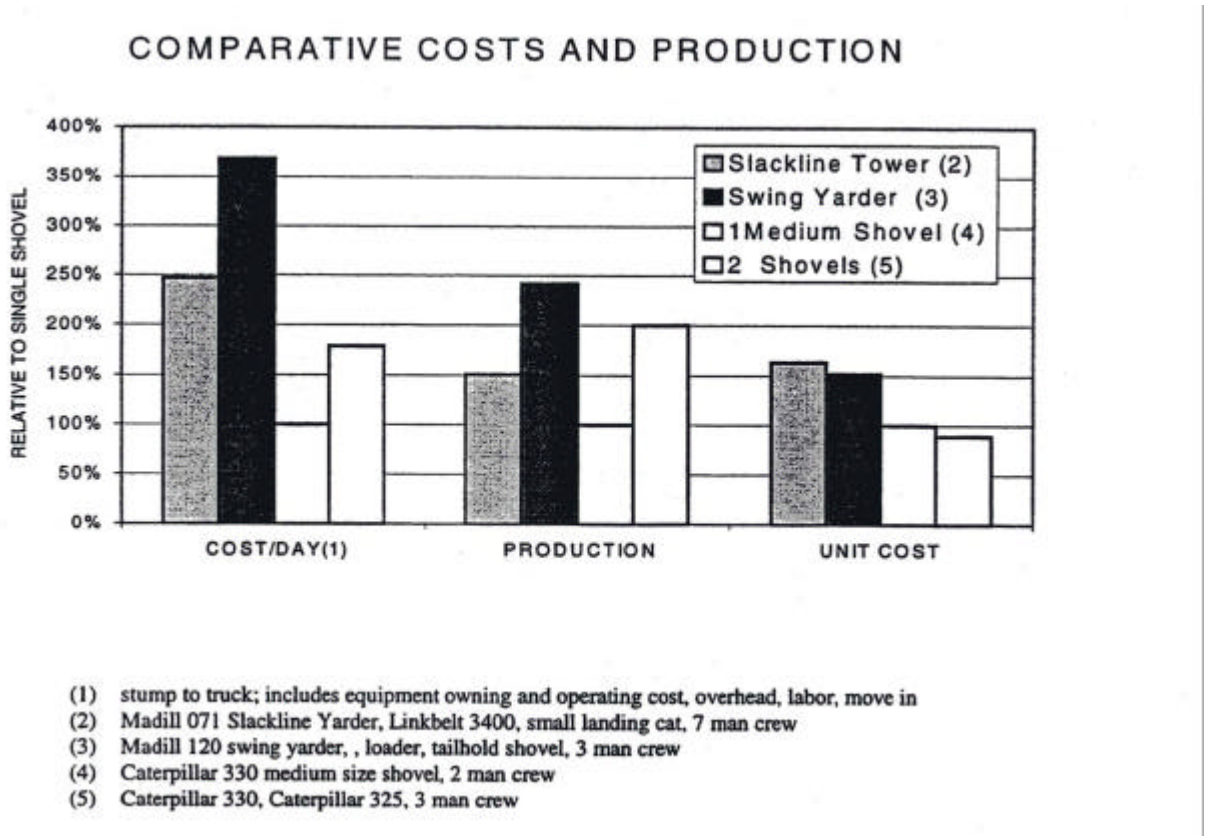

Figure 2. Cost and production of shovel logging relative to cable logging.

- External yarding distance less than 700 feet (downhill yarding)
- External yarding distance less than 400 feet (uphill yarding)
- Moderate terrain with short (<200 feet) steep pitches

A study done in Southeast Alaska indicated that the handling time for each log increased after three passes, suggesting that log deck height affects production. This apparent decrease in productivity may be offset by the fact that the relative amount of unproductive travel time decreases when the shovel is working with greater accumulations of wood.

The benefits of working two shovels together include the sharing of a landing man and efficiencies related to loading trucks.

SITE IMPACTS

The great cost effectiveness of shovel logging has pushed its application to some sites that previously may have been deemed 'cable ground'. The increased use of ground based systems on steeper terrain raises the concern of site impacts. The issues are site productivity and erosion.

Shovel logging, properly managed, causes little soil disturbance relative to other ground-based systems. Shovel logging inherently cause less disturbance than other ground based systems because:

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Shovel does not travel fast Shovel does not drag a turn The relatively low site impact of shovel logging makes it attractive to landowners with the goal of continued (sustainable) productivity of their forest lands. Shovel logging is essentially the only ground based system used on the Mount St. Helens Tree Farm. Weyerhaeuser has developed a Soil Management System to assist in achieving our stated Resource goals of protecting water quality and soil productivity. Use of Soil Management standards and guidelines has made Weyerhaeuser very successful at avoiding excessive disturbance and maintaining site productivity. Weyerhaeuser Soil Management Process has established standards based on research, and monitors performance. Soil management audits of nearly 900 acres of shovel logged ground indicated that over 98% of the acreage met soil management standards.

The components of our Soil Management System include:

- Inventory of soil types;
- Development of soil disturbance standards;
- Determination of Soil Operability Risk Rating for each soil;
- Development of Best Management Practices;
- Training of planners, engineers and operators;
- Monitoring; and
- Rehabilitation.

Implementation on the ground includes the operator being notified of:

- Soil type;
- Recommended operating window (Risk Rating); and
- Allowable depth of disturbance.

The operators are trained in recognizing unacceptable disturbance and Best Management Practices (BMP's) that avoid
it. BMP's for logging on slopes include all of the strategies described earlier that reduced the need for the shovel to travel on steep ground, (ie heeled log extension, tongs, block on the boom). Quartering or traveling parallel to slope causes less soil disturbance than sidehill travel on slopes greater than ten percent. The placing of tops and limbs in the trail can reduce the severity of the disturbance.

The sites where the shovels enter and exit the setting at the road often experience the greatest disturbance. This can be reduced by using natural breaks in topography, avoiding wet areas and using the boom to assist turning on the road.

Dirt spurs may decrease the number of logging trails and facilitate the yarding of large settings. Consideration of dirt spurs is recommended when yarding distances exceed 500 feet. Dirt spurs require the following measures to minimize loss of site productivity:

- Make as narrow as possible;
- Remove only enough top soil to safely truck logs;
- Save top soil so it can be used at rehabilitation; and
- Rehabilitate (till, replace topsoil, replace woody debris).

OPERATOR AND SAFETY

A key component of the shovel logging system is of course the operator. The operator is involved in every aspect of the operation. From the development of a strategy for logging a particular setting, to the roadside clean up at completion the

operator is responsible. The operator plans his string of trucks to maximize his productive yarding time. The successful operator is adept at manipulating the machine and knowing its limits; as well as being a good planner and strategist.

Shovel logging is inherently safer than cable logging systems based on the tremendous reduction of exposure of workers to hazards. Throughout the yarding process there is no need for any workers other than the operator to be near moving equipment or logs. The landing man can perform his work largely out of range of the equipment and moving logs. Slips and falls occur less frequently because there is no rigging crew scrambling to get in the clear.

ENVIRONMENTAL AND SILVICULTURAL OPPORTUNITIES

Shovel logging provides an opportunity to safely work around standing snags. The result is that in areas with a fire history many large old growth snags can be left for habitat. Slash treatment can also be provided with the shovel concurrent with logging or following. The use of slash puncheon for soil protection also serves to break down slash, facilitating the planting of the site. Where slash accumulations are heavy the shovel may pile, providing accessible planting sites and small mammal habitat. Planting may be facilitated by the scattering of slash it is concentrated. An administrative difficulty in accomplishing these site prep tasks concurrent with logging is the assessment of reasonable compensation that offsets the decreased logging productivity.

SUMMARY

Shovel logging was recognized as an effective logging system on gentle slopes of the Pacific Northwest in the mid 1970's. The high productivity and small crew size have made shovel logging a very cost effective system relative to other systems, ground based and cable. Shovel logging, properly managed, causes little soil disturbance relative to other ground based systems. The combination of these two attributes make it an attractive system for timberland owners seeking to capture the greatest value from their managed forests while protecting the long term productivity of their lands. Shovel logging is increasingly being utilized on settings with more difficult terrain, previously considered "cable ground".

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