California FORESTRY Note

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AN EVALUATION OF THE FMC TRACKED-SKIDDER ON JACKSON STATE FOREST

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Figure 1. FMC Model 220CA tracked skidder.

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ABSTRACT

A field time-study/performance evaluation was conducted on Jackson State Forest, Mendocino County, of the FMC Model 220CA Tracked-Skidder. Tests were conducted concurrently with normal logging operations in a residual old growth redwood stand. The FMC provided versatility and 11 percent higher production with less environmental disturbance when compared with conventional rubber-tired skidding machines in this study. With the FMC, ground-skidding can be extended to slopes from 30 percent to 50 percent while still meeting environmental requirements.

ACKNOWLEDGMENTS

This study was made possible with the cooperation of the entire Jackson State Forest staff and Forestry Aide Frank Quadro Jr., who assisted in collecting and compiling the field data.

DISCLAIMER

The mention of trade names or commercial products in this paper does not constitute endorsement nor recommendation for use.

THE STUDY

In June 1979, Harwood Products, a contractor operating on Jackson State Forest, introduced the first tracked-skidder to be used on the State Forest. While logging the Two Rock 1979 Timber Sale, Harwood Products purchased the FMC Model 220CA Choker Arch High Speed Steel Track Logging Vehicle (hereafter referred to as the "FMC"). The Jackson State Forest staff decided to conduct a broad evaluation of the performance of the tracked-skidder versus the wheeled (rubber-tired) skidder in the Cat 518 or Clark 667 category. The specific objective of the study was fourfold:

1. To compare production of the FMC versus the rubber-tired (RT) skidder.

2. To evaluate efficiency of the FMC versus the RT skidder.

3. To evaluate environmental disturbance caused by the two machines.

4. To ascertain the general advantages and disadvantages of the FMC.

THE STUDY AREA

The study area was located twenty miles east of Fort Bragg, one mile south of Highway 20, in Jackson State Forest and is described as the Southeast Quarter of Section 11, Township 17 North, Range 15 West, M.D.B.&M. The timber from this 180-acre parcel was purchased by Harwood Products, Willits, California.

The timber species consisted of residual old growth redwood (5 percent), young growth and small old growth redwood (75 percent), old and young growth Douglas-fir (20 percent), and mixed hardwoods and brush.

Topography in the study area was varied. Slopes ranged from gentle (0-15 percent) to steep (40-70 percent). Aspect was basically north while elevations climbed from 700 to 1,200 feet above sea level. This area of Mendocino County is in the California Coast Mountain Range.

California Soil-Vegetation maps classify the soil as Hugo Series with McArdle Site II timber growth capacity. During the study period the soil throughout the area was dusty and dry.

This timber harvesting operation was conducted under a State timber sale agreement and the requirements of the Forest Practice Act, Coast Forest District Rules. There were blueline streams and sensitive wet areas throughout the sale area.

METHODOLOGY

The study was conducted on five selected days during the period June 5 to July 27, 1979. To obtain the time-study/production data, study members observed and evaluated the machines, timed the individual turns, measured the skid distances, and scaled the logs. Distances were measured by pacing, slopes were measured with a Relaskop, and logs were scaled with a logger's tape and a Manley tape. Weight factors were obtained using the approximate Jackson State Forest weight-scale ratio of ten pounds per board foot, developed from scaling and weighing timber from this and similar sales.

Study members relied on visual observations backed by personal judgment and experience. Many assessments of the FMC were based directly on a subjective visual evaluation.

The following data were collected on the FMC and the RT skidder:

1. Number of skids per day
2. Species skidded
3. Log diameters and lengths
4. Board foot volume per skid (Scribner)
5. Weight per skid
6. Distance per skid
7. Average slope per skid trail
8. Turn times
9. General environmental impact
10. Hill climbing capability
11. Soil disturbance
12. Maintenance problems

SILVICULTURAL SYSTEM

Harwood Products logged the area using seven ground-skidding pieces of equipment as follows:

- Crawler Tractor, D-7 (2)
- Crawler Tractor, D-6 (1)
- Clark Skidder, 667 (1)
- Cat Skidder, 518 (2)
- FMC Skidder, 220CA (1)

Conifers 22 inches and greater in diameter were harvested under an overstory removal harvesting method. Approximately 15 MBF/acre were harvested. Skid trails were separated by a minimum ground distance of one hundred feet. Most skidding was downhill to centrally located landings. Choker setters were provided with each skidding machine, leaving operators to concentrate on equipment operation.

All skidding equipment was required not only to skid logs, but also to deck them and to keep the landing clear. Skidding machines were equipped with dozer blades and fairlead assemblies.

During the study, there were several active landings throughout the sale. However, the loading machine operator compartmentalized the loading so that he worked only two or three landings per day. This allowed the skidding operators an opportunity to skid and deck logs on the landings not being used for loading operations. Regardless, there were instances when the evaluated machines had to skid into active landings where loading operations were underway. This caused delays in some of the skids. These delays, or dead time, were included in the averaged turn time.

TIME AND PRODUCTIVITY

Study results should be interpreted with the following points in mind:

1. All operators knew they were being timed and evaluated; thus efforts in some cases may have been artificially high.

2. The FMC operator was new to the machine (250 operating hours). Although an experienced RT skidder operator of several years, his relative inexperience on the FMC caused some increases in the time factors.

3. Results are broad, general observations backed by simple field measurements in order to get a reasonable comparison between the RT skidder and the FMC.

4. On several occasions when sensitive or adverse areas were encountered, the contractor tended to use the FMC because of his personal evaluation that the FMC caused less environmental disturbance.

5. The RT (Cat 518) skidder produces 120 horsepower,[1/] whereas the FMC (220CA) produces 200 horsepower.[4/]

6. Production results are based on an observer day and not a full machine day.

The FMC as shown in *Figure 2* out-performed the RT skidder on an hourly basis.

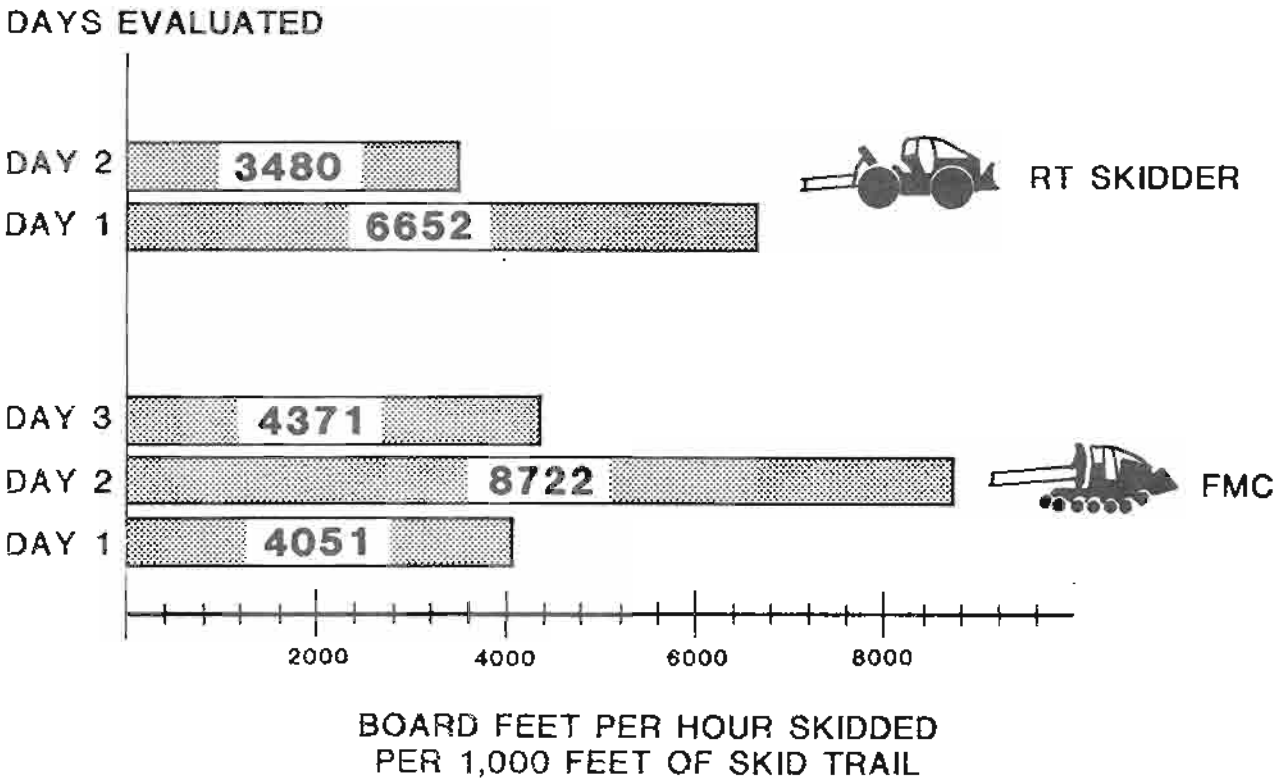

Figure 2. Production of the FMC vs. RT skidder in board foot units per hour of operation over each 1,000 feet of skid trail.

Production measurements were based on the board foot volume skidded per operating hour over each 1,000 feet of skid trail.

$$\text{This value} = \frac{\text{total volume (bf)}}{\text{total turn time (hours)}} \times \begin{matrix}\text{average skid distance} \\ \text{(in thousands of feet)}\end{matrix}$$

The FMC average production rate based on the total volume skidded over the three observer days = 5,390 bf/hr per 1,000 feet of skid trail, while the RT average production rate based on two observer days = 4,840 bf/hr per 1,000 feet of skid trail.

Then, the increased productivity for the FMC is:

$$\frac{5{,}390 \text{ bf/hr} - 4{,}840 \text{ bf/hr}}{4{,}840 \text{ bf/hr}} \times 100 = 11\%$$

The maximum skid distances measured for the FMC and the RT are compared in *Table 1*.

Table 1. The maximum skid data of each machine based on the longest skid encountered during the study.

Data	Values of Maximum Skid FMC	RT
Distance	1,200 ft.	900 ft
Speed	120 ft/min	90 ft/min
No. Logs	4	3
Volume of Skid	2,290 bf	1,270 bf
Slope	25%	43%

The FMC hauled more logs, farther, at a faster rate of speed than the RT skidder. The average round trip speed of the FMC was 78 feet per minute while the RT averaged 56 feet per minute. These figures were obtained by the following calculations:

$$\text{Average speed} = \frac{\text{total skid distance (ft) for day}}{\text{total turn time (min) for day}} = \text{feet/min}$$

The FMC and RT average speeds were based on a full observer-day of production. These values are valid for the conditions and operators measured on those study days selected for evaluation. Extrapolation of these figures would, of course, be dependent upon similar conditions. Nevertheless, these averages represent a reasonable comparison of the two machines.

As a test of the two machines in side by side competition, a hill climb, without load, was set up in a representative area of the sale. The area consisted of a 60 percent hill, 100 feet in slope distance, covered with slash and logs left from recent felling activities. The area had not been skidded.

The outcome was as expected. The FMC climbed through the grass and slash and left little trace of its passage through the area (*Figures 3, 4, and 5*). The RT skidder could climb only one-fourth of the way up the same hill before it began to bounce and dig-in to the point that it could go no farther (*Figure 6*).

Figure 3. Sixty percent hill where FMC walked between the two logs and over the seedlings.

Figure 4. Close-up of FMC track on 60 percent hill in grassy area.

Figure 5. Study member Frank Quadro points out the minimal damage caused by FMC walking up slash-covered 60 percent slope.

Figure 6. RT skidder attempted to climb 60 percent hill where FMC had "walked" up. Soil was not exposed after FMC traversed hill.

From this hill climb, it was apparent that the FMC could traverse sensitive and steeper areas and do less damage than the conventional RT skidder. According to production studies in Canada, by using the FMC "ground skidding could be extended to slopes from 30 to 50 percent and still meet production and environmental requirements." 5/

SOIL DISTURBANCE

Figures 3 through 6 emphasize the minimal site disturbance caused by the FMC when compared to the RT skidder, but further evaluation was desired. A soil compaction analysis was then established. The study members chose a flat, exposed soil area where all three machines (this test included a crawler tractor) could pass over an undisturbed test plot.

Comparisons were made between the tested machines and general overview photos were taken for comparative purposes (*Figures 8, 9, and 10*). Profiles were dug into the vehicle tracks. Each soil layer within the profile displaying any alteration due to compaction was measured and compared to an adjacent, undisturbed profile. Based on observations of relative compaction depth, the crawler tractor caused about 20 percent more compaction than the FMC while the RT skidder produced about 110 percent more compaction than the FMC.

The FMC caused less compaction than the RT skidder or the crawler (*Figure 8*). Froehlich 3/ substantiates this observation in his comprehensive soil compaction study of the FMC on three forest soils in Oregon. He also points out the reduced amount of area disturbed when using the FMC compared to a crawler tractor. *Figure 7* helps demonstrate the reasons why the FMC caused less disturbance during skidding operations.

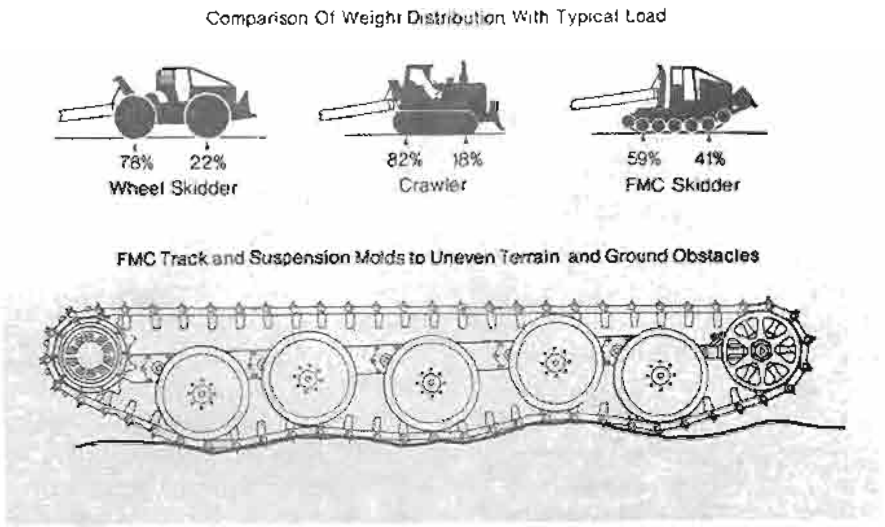

Figure 7. Comparison of weight distribution with typical skid, between wheeled skidder, crawler tractor and FMC. 2/

The FMC has only 59 percent of its weight to the rear of the machine, which is 19 percent less than the RT skidder and 23 percent less than the crawler. When combined with the ability of the FMC to suspend one end of the skidded load (under ideal conditions), this weight balance distribution contributes significantly to the FMC's ability to traverse sensitive areas without causing adverse disturbance. The FMC exerts only six psi 4/ ground pressure when loaded, while wheeled skidders exert 30 to 45 psi 1/ and a D-7 crawler tractor exerts 10.3 psi 1/ ground pressure.

Figure 8. FMC track soil compaction profile showed the least amount of compaction observed.

Figure 9. Crawler tractor soil compaction profile. Although less compaction than the RT skidder, the crawler did more compacting than the FMC.

Figure 10. RT skidder soil compaction profile revealed by far the most compaction observed.

MAINTENANCE AND DOWNTIME

During the study period, few maintenance problems or breakdowns occurred. However, discussions with other users of track-laying machines indicated the common problem of track maintenance and wear. Each track consists of 22-inch wide forged steel blocks connected with rubber-bushed steel pins for flexibility and durability 4/. The track is driven from the front and is laid on the ground rather than pulled from the rear as in a crawler tractor. But by mere numbers of parts alone, the track-laying skidder provides more maintenance potential than a rubber-tired skidder with only four tires. Track tension adjustments often become necessary, but can readily be accomplished in the field.

GENERAL FMC NOTES

Advantages of FMC:

1. Less environmental and soil disturbance.
2. Operates efficiently on steep slopes.
3. Speed (14 mph).

4. Efficiency and "pull" power.

5. Lifts one end of skidded logs.

6. More and larger logs per skid.

Disadvantages of FMC:

1. Long turning radius (24') - can't lock track like a crawler tractor (RT skidder has 17' turn radius).

2. Apron and cage makes it difficult for operator to see choker-setter and logs.

3. Can't deck as well as RT skidder.

4. High acquisition cost.

5. Exhaust system in poor location for operator.

6. Logs must be of similar sizes for the choker arch to work effectively. Otherwise the smallest logs tend to drag and dig into the ground due to unequal choker lengths.

CONCLUSIONS

The FMC appeared to be an excellent logging vehicle for conditions on Jackson State Forest, providing versatility and 11 percent higher production with less environmental disturbance than the wheeled skidder. Ground skidding capabilities were extended to steeper slopes and more sensitive areas. Considering the relative cost of the FMC ($115,000) as opposed to the cost category of the RT skidder ($70,000), the FMC should be purchased and used only where its advantages will pay off. As Powell 5/ points out in his technical analysis of the FMC, "if the terrain is suitable for wheeled skidders, the FMC's special capabilities become unnecessary and it may become an expensive substitute for wheeled skidders."

On the other hand, the generally steep slopes, abundance of blueline streams and sensitive areas of Jackson State Forest tend to support the potential use of tracked-skidders like the FMC on State timber sales.

REFERENCES CITED

1. Caterpillar Tractor Co. 1978. Caterpiller performance handbook, edition 9. "CAT" publication, Peoria, Illinois.

2. FMC Corporation. 1979. Model 220CA choker arch high speed steel track logging vehicle. FMC Corp., Woodlands Equipment Division, 2025 Gateway Place, San Jose, CA 95109. Specifications.

3. Froehlich, Henry A. 1978. Soil compaction from low ground-pressure, torsion-suspension logging vehicles on three forest soils. Forest Research Laboratory, Oregon State University, Corvallis. Research Paper 36. 12 p.

4. Miller, Robert O. General Sales Manager of FMC Corporation provided technical data, June 1979.

5. Powell, L. H. 1978. Production and performance of FMC 200 series skidders. Forest Engineering Research Institute of Canada, Technical Report #TR-29.