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COST OF WETLAND PROTECTION USING A CHRISTY CABLE YARDER

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SUMMARY:

Forest managers, loggers, land-use planners, and other decision makers need an understanding of estimating the cost of protecting wetlands using cable logging systems to harvest timber products. Results suggest that protection costs can range from $245 to $490 per acre depending on the degree of protection desired.

KEYWORDS: Harvesting costs

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ABSTRACT

Forest managers, loggers, land-use planners, and other decision makers need an understanding of estimating the cost of protecting wetlands using cable logging systems to harvest timber products. Results suggest that protection costs can range from $245 to $490 per acre depending on the degree of protection desired.

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INTRODUCTION

Wetlands and wet areas are among our most important natural areas. From a biological perspective, forested wetlands are the most productive wildlife habitat on the continent (Dept. of Fish and Wildlife Resources, 1990). In addition to providing habitat for a wide range of game and non-game wildlife species, these areas also rank as some of the most productive sites for the production of high-quality wood products. Protection of forested wetlands is a top priority with most state and federal conservation agencies. It needs to be a priority in the private sector as well. Protecting forested wetlands involves tradeoffs of wood utilizaton, protection costs, returns to the landowner, and logging costs.

Cable logging technology has been used in the Eastern United States to remove timber from environmentally sensitive steep-slope forest sites. The technology can also be used to protect wetlands while removing wood products. Results of time-and-motion studies have provided the production rate and cost estimates for cable logging systems over a range of operating conditions and sites. General costing packages have been developed and integrated with wood value and growth-and-yield projection systems for use in forest planning and decision making. Research also has shown that cable logging systems can minimize timber harvesting effects on forest sites (Patric and Gorman, 1978). Although much work has been completed and reported, decision makers, loggers, managers, and planners need to understand, and have methods for, estimating the cost of wetland protection when using cable logging systems. The challenge is greater for eastern cable logging operations where loggers are operating in a wide

range of site and stand conditions in which operating conditions can change not only from site to site but within a given logging chance.

In this study, the costs of protecting a wetland area are estimated for harvesting a mixed hardwood stand using a Christy[1] cable yarder (Figure 1). The Christy is a small, low-priced cable yarder, and the results can be applied to other yarders of the same class in similar applications.

Methods

The initial stand is a 40-acre mixed hardwood stand that averages 195 trees per acre. The principal species components are red maple, red oak, white ash, hickory, and white oak. The stand has a site index of 60, is 90 years old, with an average tree d.b.h. of 10.2 inches (trees 5-inches d.b.h. and above are included in the average). The stand at age 90 contains 4.5 Mbf/acre of sawlogs and an additional 27 cords/acre of fuelwood and pulpwood (3,317 ft^3 total).

The desired silvicultural treatment is to grow the stand to optimal rotation length of 110 years and then conduct an even-aged regeneration harvest of the stand. The rotation length is based on maximizing present net value. The stand at age 110 contains 8.7 Mbf/acre of sawlogs and an additional 28 cords of fuelwood and pulpwood (4,290 ft^3 total). The distribution by species and 2-inch diameter classes for the 110-year-old stand is shown in Table 1. The stump-to-mill logging costs were estimated with ECOST (LeDoux, 1985) and time study data for a Christy yarder. ECOST is a microcomputer program that can be used to estimate the stump-to-mill cost of cable logging eastern hardwoods.

The Christy yarder was selected because its capacity matches final harvest conditions and valuable time study data were available (Sherar and LeDoux, 1989; LeDoux, unpublished[2]). The growth and yield projections, volume estimates, and optimal rotation were estimated with MANAGE (LeDoux, 1986). MANAGE, a computer program written in FORTRAN 77, integrates harvesting technology, silvicultural treatments, market price, and economic concerns over the life of a stand. The simulation is a combination of discrete and stochastic subroutines. Individual subroutines model harvesting activities, silvicultural treatments, growth projections, market prices, and discounted present net-worth (PNW) economic analysis. The model can be used to develop optimal management guidelines for eastern hardwoods. The delivered prices for sawlogs and pulpwood were obtained from Forest Products Price Bulletins and Coastal Lumber Company, Hopwood, PA (Ohio Agric. Stat. Serv., 1989; Pa. State Univ., 1989; Tenn. Div. For., 1989) and are shown in Table 2.

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[1]The use of trade, firm, or corporation names in this paper is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

[2]LeDoux, C.B. Production rates and costs of group selection harvests with a Christy cable yarder. Unpublished report on file at the Northeastern Forest Experiment Station, 180 Canfield St., P.O. Box 4360, Morgantown, WV 26505.

The 40-acre stand is located on both sides of a wet area that includes 10 acres adjacent to a live stream as shown in Figure 2. The objective was to remove timber from both sides of the stream to a landing on the truck road while simultaneously protecting the stream and adjacent wetlands.

The area would be harvested under an even-aged management plan, harvesting all merchantable timber at the optimal rotation age of 110. The protection options evaluated include: (1) no protection, regenerate all 40 acres; (2) leaving the wet area as a buffer zone on both sides of the stream and not removing any wood from this zone; (3) leaving a buffer zone on both sides of the stream, but selecting some timber from within the buffer zones (approximately 50% of the volume) and allowing logs to drag across the stream and wet areas; and (4) option 3, and requiring full suspension of the logs across the stream and wet areas. A wetland is defined as an area that is periodically wet and flooded, but which dries up during periods of low rainfall, thus allowing trees and other vegetation to grow on the dry soil.

Results

Option 1 affords the least protection to the wet-area and stream but results in the most net revenue to the land owner and the highest utilization of wood in the stand (Table 3). Leaving a portion of the stand as a buffer zone, option 2, removes 1,072 ft^3/acre less wood and results in $490/acre less net revenue than option 1. Option 3 removes more wood from the stand and returns $245/acre more to the land owner than option 2. Although option 4 removes the same amount of wood as option 3, the logging cost increase of about 11% reduces the net revenue by $199/acre. The increase in estimated logging cost is due to additional bucking of logs to meet full-suspension payloads, smaller payloads, and the additional rigging required to attain full suspension. It is beyond the scope of this paper to detail the bucking, payload, and additional rigging costs incurred. The intent is to illustrate a method that can be used to estimate wetland protection costs and provide representative protection costs for the options specified.

If the revenue reductions from options 2-4 versus option 1 are interpreted as the cost of wetland protection, then the treatments evaluated result in protection costs that range from $490/acre for option 2 to $245/acre for option 3 (Table 3). The additional protection of fully suspending the logs over the stream and wet areas, option 4, results in a protection cost of $444, which is only $46/acre or about 9% less than option 2. However, option 4 takes 536 ft^3/acre more wood than option 2. The tradeoffs of wood removal, return to the landowner, protection costs, and logging costs must be evaluated carefully for each specific set of conditions.

Revenue reductions attributed to site protection occur only once at the beginning of the rotation. However, wetlands protection benefits accrue throughout the next rotation. To compare future costs and benefits, a capital recovery factor can be calculated to convert revenue reductions to a series of uniform annual costs that begin at the time of harvest and extend through the next rotation. The annual costs shown in figure 3 have net present values equal to the revenue reductions estimated for protection options 2, 3, and 4. These annual costs vary by protection option and interest rate, ranging from $5.52/acre/year for option 3 and a 2 percent interest rate to $29.42/acre/year

for option 2 and a 6 percent interest rate. These results demonstrate that harvesting revenue forgone today can represent a sizable annual opportunity cost against which future benefits must be weighed.

Although MANAGE evaluated only one mixed hardwood stand, cable logging technology, and four protection treatment options, the results show that protection costs can be substantial depending on the level of protection desired. Protection costs are also dependent on topography, road location, and the desired width of the wetland protection zone. These variables generally determine slope yarding distance and the profile width of the protection zone, which in turn determine the proportion of total area and volume affected by wetland protection measures. For example, yarding 1200 feet with a protection strip up to 300 feet wide reduces harvesting revenue by 25 percent or less, depending on the cutting level permitted on the protection strip (Figure 4). For shorter yarding distances, revenue reduction increases rapidly with increases in the width of the protected wetland.

Protection costs also will change with other protection objectives, product values, yarding systems, market locations, crew efficiencies, and many other factors. However, protection scenarios could be easily evaluated by projecting existing stands to optimal rotation age, estimating logging costs and revenues for final or intermediate harvests, and then focusing on the tradeoffs of protection costs, returns to the landowner, and the logging costs necessary to achieve the desired objective. The results can be used to assist decision makers, loggers, managers, and planners in understanding the costs involved in protecting wet areas for several treatment options. The tradeoffs to wood utilization, costs, and returns to the landowner depend on the objectives chosen.

The final decision and end results are up to the decision maker.

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Table 1. Stand table at age 110 years.

Tree Species	Midpoint of 2-inch dbh class (inches)										
	6	8	10	12	14	16	18	20	22	24	26
	No. trees/acre										
Hickory	14	11	3	2	3	0	1	3	--	--	--
Red maple	1	0	1	--	--	--	--	--	--	--	--
Red oak	4	17	5	3	4	5	2	0	1	2	1
White ash	7	4	4	4	3	4	0	0	3	0	1
White oak	14	15	12	12	9	6	3	3	1	3	1
Total	40	47	25	21	19	15	6	6	5	5	3

Table 2.--Delivered prices for sawlogs and fuelwood/pulpwood by species.

Species	Product: Large[1] high-quality sawlogs	Medium[2] size and quality sawlogs	Small[3] low-quality sawlogs	Fuelwood/[4] Pulpwood
	---------- $/Mbf (Doyle Rule) ----------			$/Cord
Red maple	210	160	80	30
White ash	500	300	100	30
White oak	500	300	100	30
Red oak	600	350	100	30
Hickory	210	160	100	30

[1]Minimum small-end diameter $\geq$ 13 inches, length $\geq$ 10 feet.

[2]Minimum small-end diameter $\geq$ 11 inches, length $\geq$ 8 feet.

[3]Minimum small-end diameter $\geq$ 10 inches, length $\geq$ 8 feet.

[4]89 ft^3/cord, minimum small-end diameter $\geq$ 4.0 inches that will not make large, medium, or small sawlogs.

Table 3.--Costs and revenues by protection treatment for harvest of a 40 acre stand at optimal rotation age of 110.

Protection Option	Volume removed (ft^3/acre)	Cost	Revenue		Protection Cost[1]
		Logging	Gross	Net	
		($/acre)			
1	4,290	2,072	4,030	1,958	--
2	3,218	1,554	3,022	1,468	490
3	3,754	1,813	3,526	1,713	245
4	3,754	2,012	3,526	1,514	444

[1]Difference in net revenue from option 1

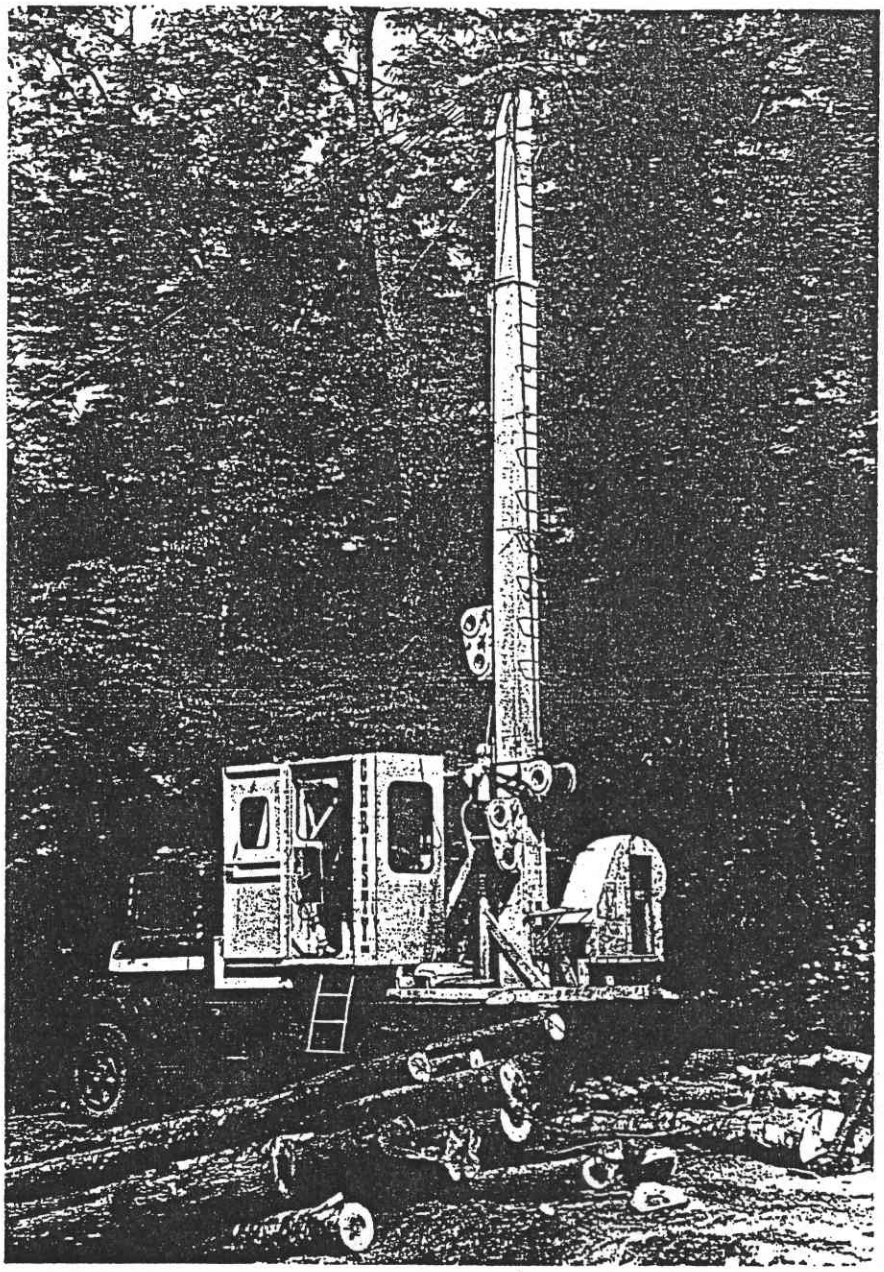

Figure 1.--Christy Yarder.

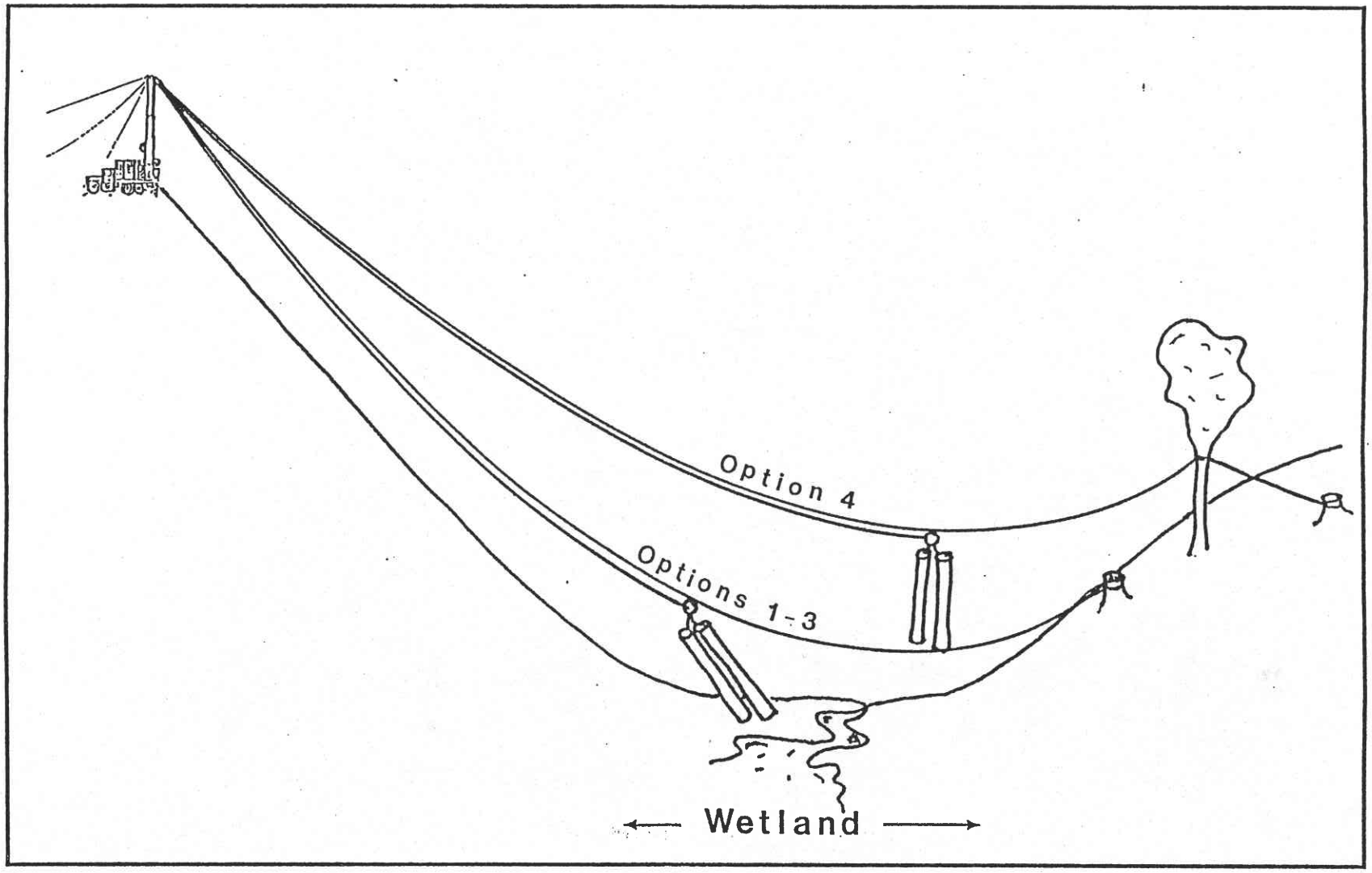

Figure 2.--Harvesting options offering different levels of stream protection.

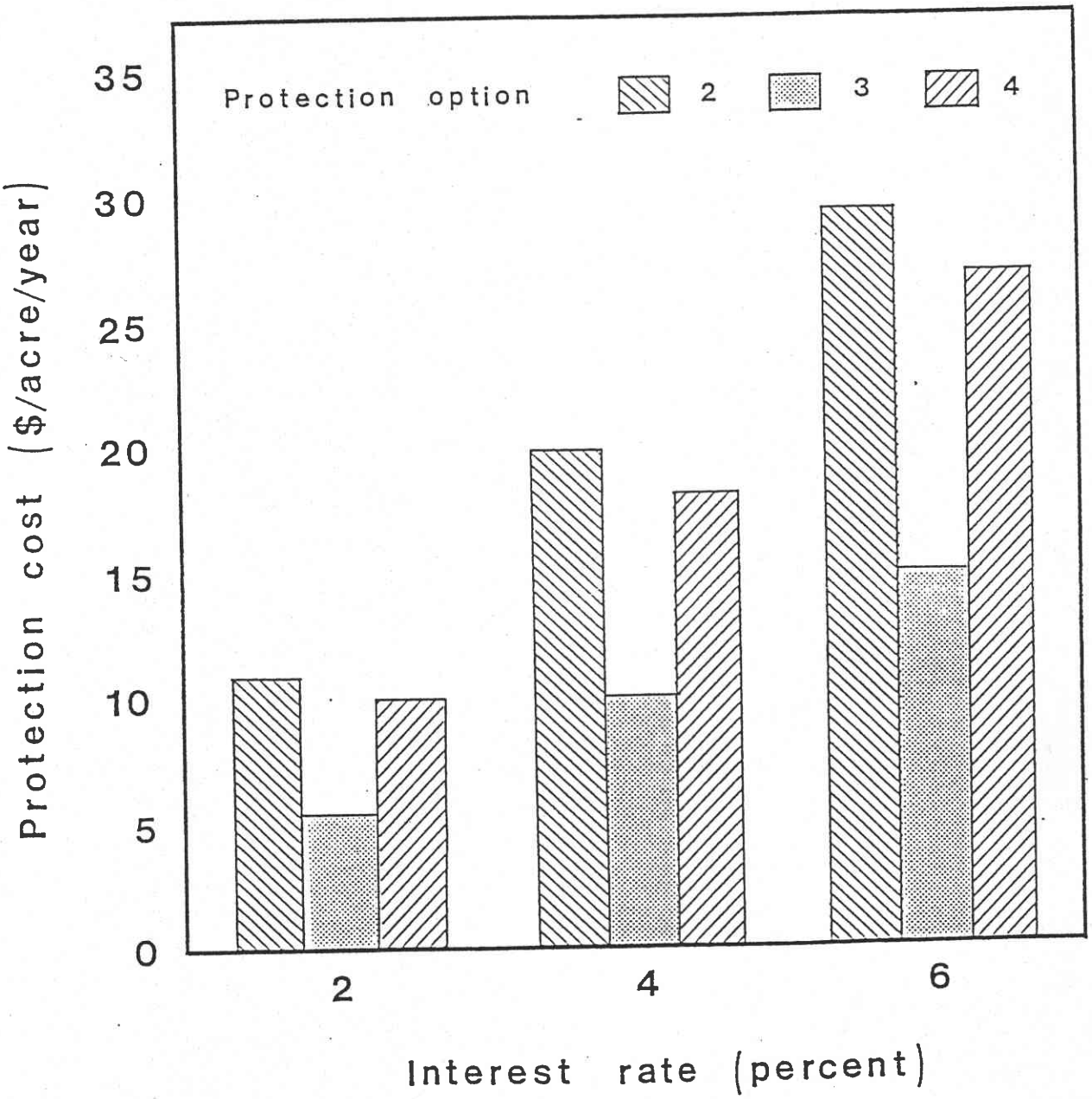

Figure 3. Uniform annual costs equivalent to harvest revenue reductions resulting from protection options 2, 3, and 4.

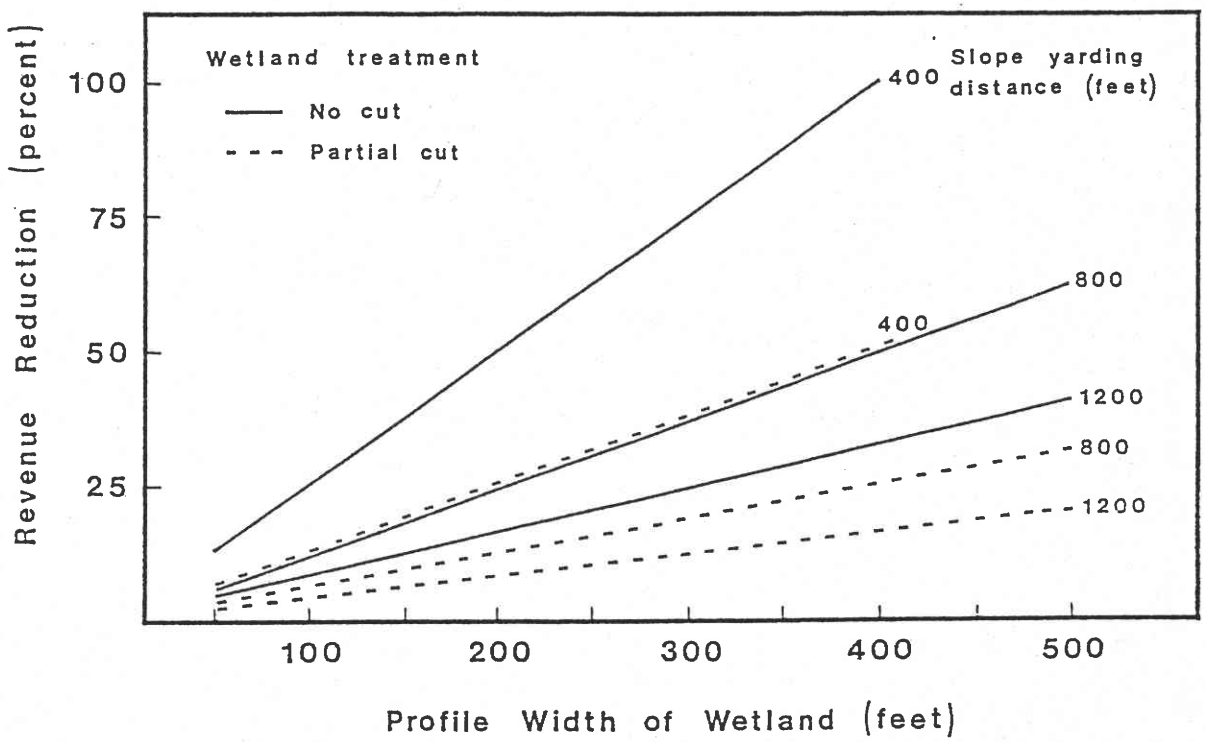

Figure 4. Harvesting revenue reductions and harvest unit dimensions.