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BUFFER STRIPS:
A POSSIBLE APPLICATION OF DECISION THEORY

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The BLM manages about 2 million acres of high quality Douglas fir timberland in Western Oregon. Policy states that the BLM will strive for a combination of resource uses on these lands that will meet the people's need and protect the resources from deterioration.

The job of a land manager is becoming increasingly complex. He is forced to handle increasingly sophisticated inputs from disciplines such as forestry, watershed, soils and fisheries as well as social, political and economic factors.

This paper represents the efforts of a land manager to use the principles of decision theory to help arrive at a management decision. Only two of the many factors involved will be considered in this paper; namely, forestry and fisheries. The paper will deal with a proposed timber harvest along a stream used for spawning by coho salmon.

Since exact quantification of fishery values is impossible with existing information, the analysis will deal in extremes and work with ranges. Minimum values will be used for fishery resources while maximum values will be used for the timber resource. In order to accomplish this, an intentional bias will be introduced at the outset.

Table A — Average stumpage price, Eugene District.

Fiscal Year	Stumpage per MBF
1965	$47.90
1966	52.19
1967	45.75
1968	42.58
1969	86.74

Table A lists the stumpage prices received in the Eugene District over the past five years. In order to maximize timber values, $150 per M b.f. will be used as the stumpage value in this report. In addition, the 40 M b.f. per acre is approximately 25% over the cruiser's estimate of what is actually on the ground.

In order to minimize the fishery values involved, a cutthroat fishery currently in existence, both on anadromous and resident fish, has been completely ignored. Likewise, the data on which the value of a sport caught coho salmon (6) is based were collected in 1962. No allowance has been made for the inflationary rise between 1962 and the present time.

The net effect of the intentional bias is to present a situation which gives all possible advantage to the timber resource. Thus, any tradeoffs between the fishery and timber resources that may be hypothesized on the basis of the following analysis would tend to have increasing validity as the parameters approach normality.

Fishery experts estimated that this particular stretch of stream would furnish 53 coho salmon to the commercial fishery and 35 coho salmon to the sport fishery annually. All of these fish would be taken off-site, primarily in the ocean.

Given these approximations, the next step is to assign a monetary value to these fish. For the commercially caught coho, it would be safe to assume that the 53 fish weighed an average of 10 pounds apiece for a total weight of 530 pounds. The value to the fisherman at dockside of this poundage is about 40¢ per pound (7) for a total value of $212. Please note that this is the value to the fisherman at dockside and does not contain any multipliers for processing or wholesaling. This is roughly equivalent to the stumpage figures which will be used for timber. The 35 sport-caught coho represent $64 apiece (5) for a total value of $2240. Studies have shown that this figure is the amount spent in Oregon to catch one anadromous fish. Summing up, the total annual monetary contribution of the stream involved in this analysis is $2452 annually.

In order to make the fishery values comparable to the timber values, the present value of this annuity for a period of 80 years using a 5½% interest rate (8) is $43,964. The use of the 80 year period may warrant further explanation. The fishery resource could be looked upon as a perpetual return and capitalized as such in the analysis. However, the land will be managed on an 80 year cycle as determined by the rotation age of the timber involved. Theoretically, an analysis of this type would have to be made again in 80 years when the second crop of timber is ready for harvest. Likewise, the use of a 5½% interest rate warrants further discussion. It is recognized that the timber industry currently endures interest rates ranging from 8% to 12%. However, long term investments are evaluated and compared within government at 5½% and this rate is used here for the sake of consistency.

Using the maximum values for timber as discussed above, it is estimated that the buffer strip along the stream will average 100 feet in width. This would amount to a total of 7.5 acres. Maximum timber volumes on this stretch would be about 40,000 board feet per acre for a total of 300 M b.f. of Douglas fir timber involved in the proposed buffer strip. Using an average stumpage price of $150 per thousand, the present value of this timber volume would be $45,000. The next step in this hypothetical problem would be to analyze the alternatives involved and the various results that could be anticipated under each alternative. For the purposes of this study, I will use three alternatives; namely, a 100-foot buffer strip reserving all timber within the strip itself; a partial buffer strip in which all merch timber is removed but in which no logging will be permitted across the stream itself; and no buffer strip in which the sale boundary is located across the creek and logging takes place without restrictions. Each of these alternatives will be analyzed in light of five different possible conditions. It will be assumed that for each alternative there is a possibility of doing no harm to the fishery, reducing production of the fishery by 20% for a five-year period, reducing the run by 40% for a five-year period, reducing the run by 60% for a five-year period, all with full recovery after the five-year period, and obliterating the run entirely.

The first step of applying decision theory to this problem is to construct a present value matrix which is shown in Table 1. This table shows a present value of each of three alternatives under each of the assumed conditions. In the case of the 100-foot buffer strip, values shown are those produced by the fisheries only. It is assumed in this alternative that the Douglas fir timber within the buffer strip will not be harvested and thus will provide no monetary returns. The values shown for the partial buffer strip are a combination of the fishery and timber values for each of the various conditions. The last cell in this row shows the value for the timber only as it is assumed that the fishery has been obliterated. Likewise, the values shown for no buffer strip are a combination of both timber and fishery values except the one cell under the assumption that the fishery run has been obliterated. This table then shows the present value that can be expected under each alternative under the various conditions listed.

Table 1. Present value matrix.

	Conditions				
Alternatives	No Harm	20% Reduction	40% Reduction	60% Reduction	Obliteration
100 ft. buffer	43,964	42,079	39,982	37,890	-----
Partial buffer	88,964	87,079	84,982	82,890	45,000
No buffer	88,964	87,079	84,982	82,890	45,000

The probability matrix (Table 2) shows the probability of the various conditions occurring for each alternative. For example, it is estimated that nine times out of ten no damage would occur to the stream using a 100-foot buffer strip while there is a one in ten chance of reducing the runs by 20%. Using no buffer strip, it is estimated that we have a five out of ten chance to reduce the runs by 60% and a three out of ten chance of destroying the runs entirely.

Table 2. Probability matrix.

Alternatives	No Harm	20% Reduction	40% Reduction	60% Reduction	Obliteration
	Conditions				
100 ft. buffer	.9	.1	0	0	0
Partial buffer	.1	.2	.4	.2	.1
No buffer	0	.1	.1	.5	.3

The next step is to construct a pay-off matrix which is shown as Table 3. The values shown in this matrix are obtained by multiplying the present value shown in each individual cell in Table 1 by the probability shown in the corresponding cell in Table 2 and entering the result in the corresponding cell in Table 3. This table should then show us the excepted pay-offs from each of the alternatives under each of the assumed conditions using the probabilities we have assigned.

Table 3. Payoff matrix.

Alternatives	No Harm	20% Reduction	40% Reduction	60% Reduction	Obliteration	Total Expected Payoff
	Conditions					
100 ft. buffer	39,567	4,208	-0-	-0-	-0-	43,775
Partial buffer	8,896	17,416	33,993	16,578	4,500	81,383
No buffer	-0-	8,708	8,498	41,445	13,500	72,151

One item that becomes immediately apparent is the fact that, in this case, the present value of the anadromous fishery ($43,964) essentially offsets the present value of the timber ($45,000), even using highly inflated values for the timber and ignoring the increased logging costs that would be inherent in a full or partial buffer strip. Many foresters hesitate to acknowledge this point, although in actuality, it is probably a fairly common occurrence. The question is not one of fish or timber. The two resources are not necessarily mutually exclusive, and the job of the decision maker is to determine which alternative will give the greatest return for a combination of the two resources.

The decision logic tables developed here can help in making this determination.

The analysis shows two defensible courses of action. It does not indicate which is the best alternative to adopt. This is where the decision maker comes in. He has a fully developed analysis to work with, but this does not relieve him of the responsibility for making a decision and living by its consequences.

One obvious course of action would be to adopt the partial buffer alternative. As shown in Table 3, this alternative would give us the highest total expected pay-off in the long run.

The prudent decision maker should also look at Table 2. He should realize that with the partial buffer alternative, he has a one in ten chance of obliterating the fishery entirely. He may not be willing to take this chance, in which case he may conceivably choose the 100 ft. buffer alternative. Here, he realizes he is sacrificing the timber returns, but he has a nine out of ten chance of receiving a fishery income which offsets the timber value. Thus, the decision maker, with his insight and expertise, remains the key element in the process.

Basic decision theory may prove very helpful in equating diverse resource values. It is a simple, step-by-step process which allows a decision maker to display all of the available facts and incorporate his best judgment where facts are lacking. It does not in itself present a solution to any problem, but it assures that the decision maker gives full consideration to all resource and values and is basing a decision on an objective analysis rather than an intuitive guess.

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