The Economics of Douglas-fir vs. Red Alder[1]

OVERVIEW

In this paper we examine how to perform an economic analysis involving investments in Douglas-fir and/or red alder plantations in the PNW. We assume throughout that our objective is to select investments which maximize the per acre net present value (NPV) under forestry -- other land uses are excluded from consideration. Step one of the analysis is to calculate the per acre soil expectation value (SEV) assuming that we plant predominantly Douglas-fir or red alder. (In many cases, stands contain a mixture of both species.) The results from step one tell us which species to plant to maximize the SEV starting from a bare land condition. Step one also indicates the best silvicultural pathway to adopt (following planting) as well as the optimal rotation age for the planted crop. Step two of the analysis (the transition phase) considers the situation where the land is currently not bare, but is occupied by an existing stand and we wish to determine how long this stand should be carried prior to converting to the optimal strategy determined in step one. Combining the results of steps one and two leads to the optimal strategy to manage a given acre of forest land. The two step analysis is conducted on a per acre basis and does not include constraints and/or considerations often included in a forest-level analysis. For example, in such an analysis, we include harvest flow, budgetary, habitat management, riparian, land slide, or other forms of management considerations that typically result in changes to the strategy produced by the two step approach.

PER ACRE ECONOMIC ANALYSIS – STEP ONE

In this paper we assume even-aged management wherein stands are established via planting and are harvested via clearcutting at the appropriate age. No other forms of silvicultural treatments are assumed for either Douglas-fire or red alder. Annual interest rates of 4-8% are used when computing all SEV's and the stumpage prices ($/Mbf) used are as shown in Tables 1 and 2. These stumpage prices are reflective of current prices but are solely for illustrative purposes. Expected timber yields are shown in Table 3 and 4. The yields are derived from Washington State's DNR empirical yield tables for Douglas-fir and predominantly red alder stands and are reported in Mbf Scribner to a 6-inch top in 16 ft. logs and include all trees $\geq$ 7 inches DBH. Yields shown in the DNR yield tables are reduced 25% to account for operational fall-down, riparian set asides, irregular density considerations, etc. As with stumpage prices, these expected yields are represented solely for illustrative purposes. For all silvicultural regimes reported

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herein, a stand establishment cost of $195/acre, an annual cost of $10/acre/year, 2-0 planting stock and no regeneration delay are assumed.

All per-acre SEVs are computed before-tax as:

$$SEV = [QP - E(1+i)^{(A-2)}] / [(1+i)^{(A-2)} - 1] - a/i$$

Table 1. Douglas-fir Stumpage Prices in Today's $s by Site Index

Age	85	105	125	145
30	237	261	273	288
35	279	302	313	331
40	317	340	353	371
45	351	374	390	407
50	385	405	424	441
55	416	439	458	472
60	447	467	489	503
65	473	498	517	535
70	500	525	545	560
75	527	552	573	588
80	550	576	598	614
85	576	600	622	639
90	599	625	644	662

Table 2. Red Alder Stumpage Prices/Mbf in Today's $s by Site Index

Age	80	100	120
25	297	329	358
30	311	348	377
35	325	362	396
40	338	380	415
45	356	399	435
50	369	413	454
55	383	432	477
60	400	450	500

Table 3. Douglas-fir Yields (Mbf/acre) by Site Index

Age	**85**	**105**	**125**	**145**
30	2063	4542	8024	12536
35	4154	7900	12802	18800
40	6246	11258	17581	25065
45	8838	15210	22958	31856
50	11430	19162	28335	38646
55	14249	23354	33904	45515
60	17067	27546	39473	52383
65	19930	31764	44998	59074
70	22793	35982	50523	65765
75	25576	40092	55863	72140
80	28360	44202	61204	78514
85	30978	48118	66284	84510
90	33597	52034	71364	90507

Table 4. Red Alder Yields (Mbf/acre) by Site Index

Age	80	100	120
25	2580	4778	7220
30	3932	6830	10002
35	5441	9080	13029
40	7068	11492	16262
45	8788	14036	19668
50	10572	16682	23214
55	12394	19402	26870
60	14227	22168	30605

Where,

Q = expected timber yield (Mbf)/acre)

P = expected timber price ($/Mbf)

(A -2) = investment period length (years) with 2-0 planting stock and A = age of timber at harvest

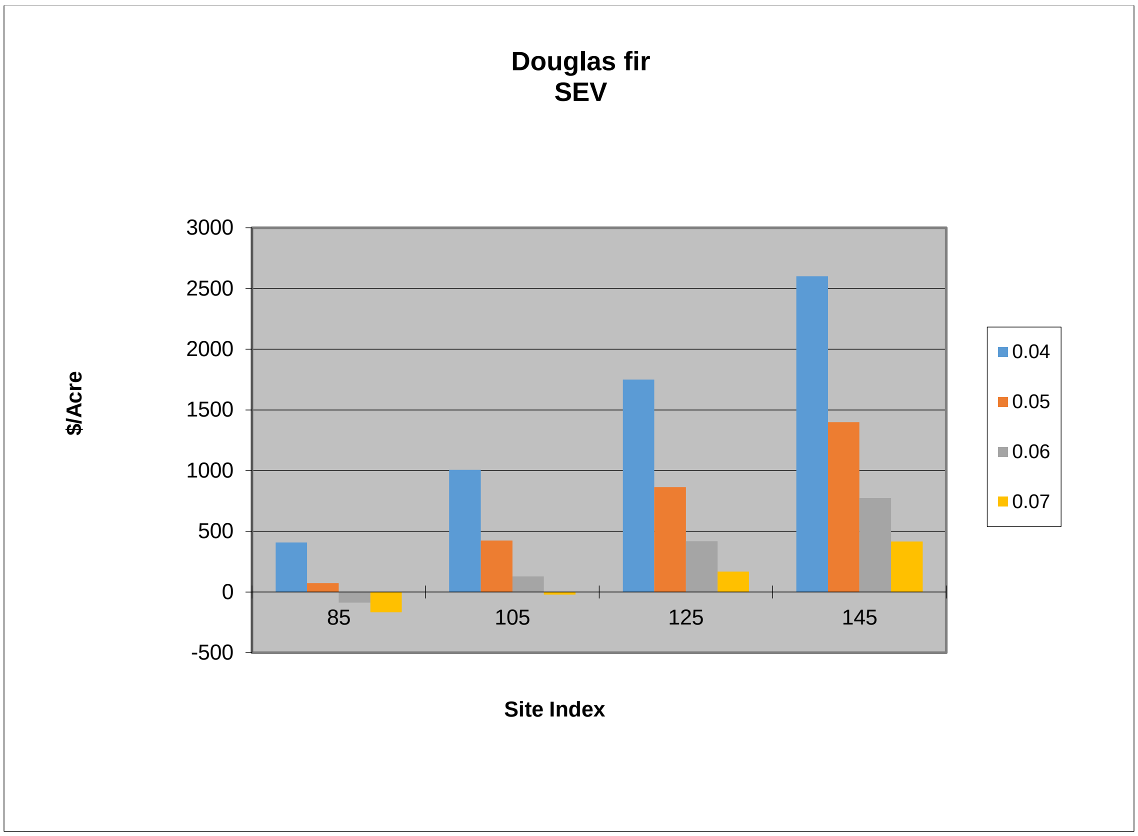
i = annual interest rate

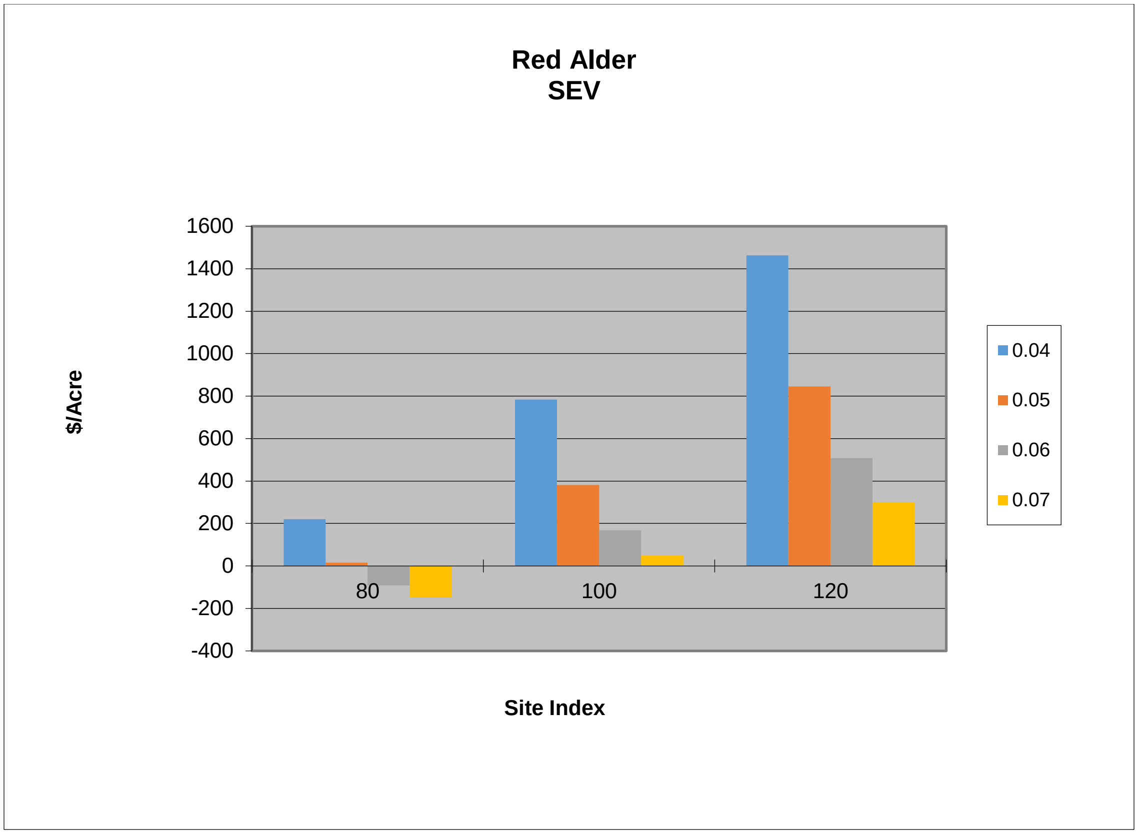
E = stand establishment cost/acre

a = annual cost/acre/year

Based on the assumed inputs as described above, the results of the first step of the SEV per-acre analysis are shown below. Care must be taken when comparing the SEVs across the two species due to site index differences and, that in many instances, it is not possible to grow both species on the same acre of land. Further, the yield tables measure mixtures of species other than Douglas-fir and red alder. The plots used to estimate the Douglas-fir tables average 64% Douglas-fir, 21% western hemlock and 6% red alder while the comparable values for the red alder tables are 62% red alder, 17% Douglas-fir and 6% western hemlock.

SEV results indicate that Douglas-fir is preferred to red alder across site classes and interest rates. In some case, however, the differences are not great. This indicates that additional analysis may be required if owners are interested in pursuing this further.





PER ACRE ECONOMIC ANALYSIS – STEP TWO

As mentioned at the outset, step two of the analysis (the transition phase) considers the situation where the land is currently not bare, but is occupied by an existing stand and we wish to determine how long this stand should be carried prior to converting to the optimal strategy determined in step one. While, in many cases, it may be desirable to immediately convert the existing stand on the acre to the optimal species, it may turn out that the existing stand should be carried for several years prior to this conversion. Step two of the analysis helps answer this question.

We use the following equation for this purpose:

$NPV = (HV + SEV)/ (1+i)^t – a[(1+i)^t – 1]/[i(1+i)^t]$

Where,

HV = the expected harvest value/acre when the existing stand is harvested

SEV = the per-acre soil expectation value determined in step one

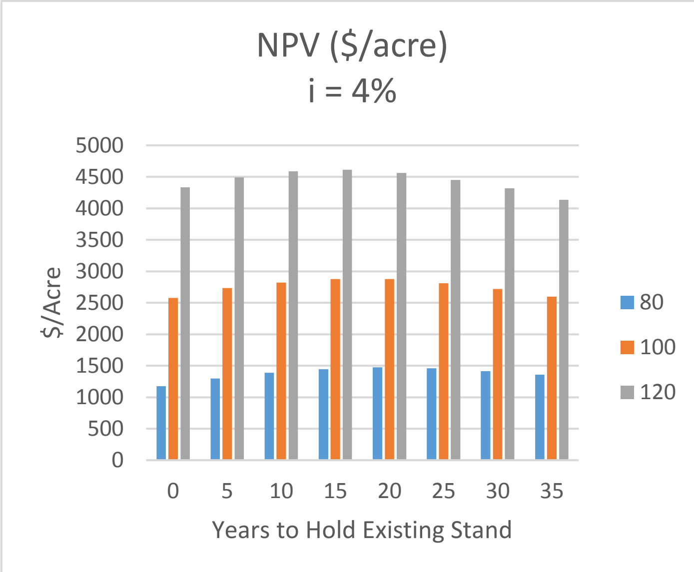
t = the number of years the existing stand will be held before conversion occurs

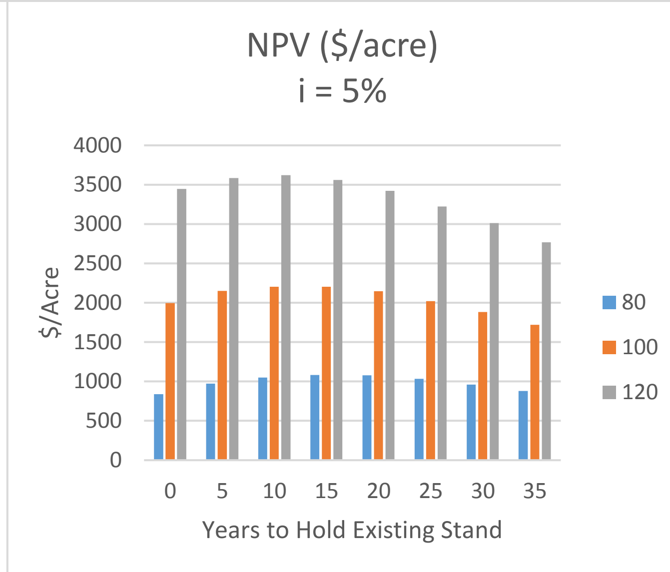
NPV = the net present value/acre of the conversion strategy

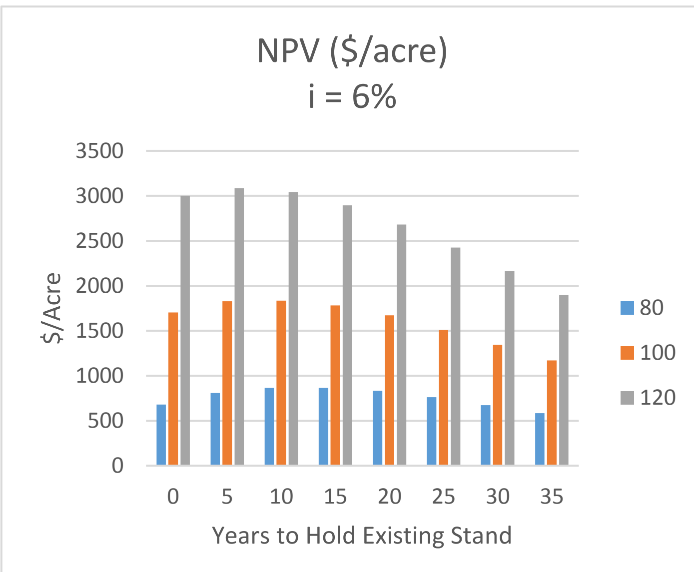
All other terms are as defined earlier.

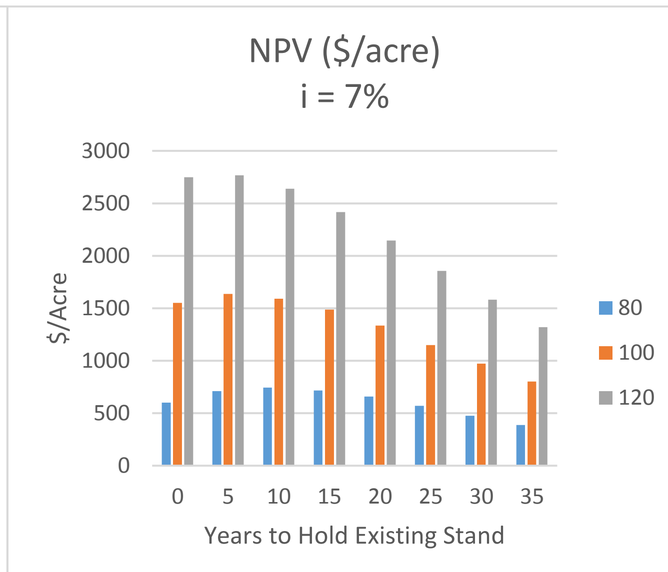
For purposes of illustration, all NPVs shown below assume that a 25-year old stand of red alder exists on the acre at the present time. When harvested, the acre will be planted to Douglas-fir as it has a higher SEV. We also assume that red alder site indices of 80, 100 and 120 are comparable to Douglas-fir site indices of 85, 105 and 125, respectively. We evaluate the above NPV equation for values of t = 0,5,10, etc. and select the holding period (t) which yields the highest NPV for a given interest rate. The optimal holding periods and NPVs as a function of the red alder site index and interest rate are shown below.

Interest		Optimal Holding Period (years)	
Rate	80	100	120
0.04	20	20	15
0.05	15	15	10
0.06	10	10	5
0.07	10	5	5


NPV ($/acre)
i = 4%
$/Acre
Years to Hold Existing Stand
80
100
120


NPV ($/acre)
i = 5%
$/Acre
Years to Hold Existing Stand
80
100
120


NPV ($/acre)
i = 6%
$/Acre
Years to Hold Existing Stand
80
100
120


NPV ($/acre)
i = 7%
$/Acre
Years to Hold Existing Stand
80
100
120

The results conform to our expectations because as the interest rate increases the holding period becomes shorter. This occurs because the opportunity cost (i.e., land rent) of not clearing the existing stand and starting the new timber crop increases as the holding period increases. We also note that the holding period becomes shorter as the site quality increases. It is also interesting that in no case do we clear the existing 25-year old alder stand at age 25. Rather, it is always better to let the stand grow at least five years and, in many cases, 10 or more years before harvesting. This occurs because the red alder and Douglas-fir timber values are approximately equal – resulting in SEVs of about the same magnitude. Thus, the rate of value growth of the red alder stand is about equal to the land rent incurred by delaying the harvest.

CONCLUSION

As stated at the outset of this paper, combining the results of steps one and two leads to the optimal strategy to manage a given acre of forest land – whether the acre is bare or covered with an existing stand. The two step analysis demonstrated in this paper does not include many constraints and/or considerations often included in a forest-level analysis. However, the two step approach provides basic information for forest managers concerning the relative economic value of the alternatives examined. It also should be emphasized that the examples included in this paper are included as illustrative and should not be interpreted as the final word on the economics of red alder vs. Douglas-fir. By using other yield tables and/or economic parameters it is likely that different results will be obtained. However, the results shown above do illustrate the correct methodology to use in making the proper assessment.