SEWARD'S FOLLY, SALMON MANAGEMENT, AND DISCOUNTING RATES

Ray Hilborn, Hilary Lee, Ralf Yorque

June 1975 WP-75-59

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by

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Some months ago, the ecology project gave a series of two IIASA colloquia on some of the approaches to the salmon case study. Part of the presentations dealt with optimization of various components of the salmon system. These optimizations were done using stochastic dynamic programming. Some members of the audience expressed concern over the fact that we had used no discounting. Carl Walters explained that we did this because the management agencies are charged with management in perpetuity and therefore any sort of discounting seems a bit inappropriate. Some recent work has shown that optimal management practice of fisheries is seriously affected by discounting rates. The standard example in extremis of this problem has to do with any renewable resource. If the rate at which the resource grows, be it trees, fish or whatever, is less than this discounting rate, then simple economics tell us to completely eliminate the resource. This does ignore the fact that the value of the resource may increase due to scarcity as it is eliminated. However, for anyone managing a single salmon watershed or a forest plot such considerations are insignificant. Fortunately, salmon have population growth rates well over 50% per annum, so there is not much chance that economic optimization will tell us to eliminate all salmon stocks. Many other fisheries, though, are less productive, and if discounting rates ever stay at 10% (the official rate in some countries) for very long, we may see our economist friends advising us to catch all of those silly fish while they are still worth some money.

What are reasonable discounting rates? This topic is one of the most hotly contested at IIASA, but we have yet to see a working paper or research report address this problem. Some rumor has it that Professor Raiffa has produced a book that solves this problem. Bill Nordhaus has been heard to say, "I never discount utility, but I do discount value." If we are going to discount, what sort of value should we use? Not knowing much economics, and probably being better off because of it, we decided to take a look at some previous large scale regional management systems to see how sensitive the cost-benefit ratio is to the discount rate. This is really a variant of the retrospective case study approach. Actually, this whole paper was prompted by a brief note we read in some scholarly journal (TIME and STERN come to mind) that if the Indians who sold Manhattan Island for $24 had put the money into a London bank and left it there for the past 350 years, they would have accrued more interest than the entire state of New York is worth. This had apparently been calculated from the prevailing interest rates in London banks during the past 350 years. Turning the tables, this means that really the Dutch traders got a very poor deal on their money. Instead of buying some useless open air storeroom for long-houses, they should have put their money in the bank. Any good operations researcher could have done a cost-benefit analysis and told the Dutch traders to hold on to their money and buy Spanish doubloons instead. Since our scholarly journal didn't give all the facts of the Manhattan purchase, we decided to rework it from a new point of view. For a series of discounting rates, we will see how much Manhattan would have to be worth now to have made it a

good deal. Furthermore, we will see how sensitive the current value of the purchase is to the discounting rate.

Unfortunately, Manhattan was bought a long time ago, 350 years, and some people might think that is a bit too long to worry about. God knows IIASA only runs on 5-year agreements. Therefore, we have also looked at two other, more recent, similar investments, the Louisiana Purchase, which was bought from Napoleon when he had cash flow problems for 27 million dollars in 1803, and the purchase of Alaska from Russia by the United States in 1867 for 7 million dollars. These two purchases, like the purchase of Manhattan, have been often touted as some of the best buys ever made (except, of course, for Xerox stocks in the early days of the company). Table 1 presents the results.

Table 1. Value of the original investment at differing interest rates. All prices in dollars per acre.

	Land Acquisition		
	Manhattan Island	Louisiana Purchase	Alaska
Year purchased	1626	1803	1867
Price paid	$24	$27,000,000	$7,000,000
Interest rate			
1%	$.04	$.28	$.05
3%	$40	$8.11	$.45
5%	$33,000	$207	$3.47
7%	$24,000,000	$5,661	$26.66
9%	$10 billion	$140,000	$205
11%	$8 trillion	$3,000,000	$1,466

The results in Table 1 are quite striking. Even for the purchase of Alaska, only 108 years ago, the value of the land goes up nearly an order of magnitude with a 2% change in the interest rate. The money paid for Manhattan, which could have been compounding interest for 350 years, goes up about three orders of magnitude for every 2% change in the interest rate. It is thus obvious that for any renewable resource -- which means a long time horizon -- small changes in the discount rate can have very large effects on the cost-benefit ratio. Returning to the original question, what are the appropriate discount rates? For Manhattan it is obvious that the land values fall between $33,000 and $24,000,000 per acre. Thus, 5-7% would be appropriate. For the Louisiana purchase, the value/acre probably falls between $207 and $5,661, so again 5-7% seems appropriate. The value of land in Alaska is a bit harder to assess, but $205 per acre seems clearly to be an upper limit, with $.45 or $3.47 being a reasonable lower limit. Thus, 5-9% seems appropriate.

However, the purchase price is in original dollars, at least for the Louisiana Purchase and Alaska, so the calculated interest rate is not inflation free. If we chose 6% as an appropriate discount rate, we have to subtract the average inflation rate. This probably brings the actual discount rate to between 1-3%. We don't wish to actually prescribe a discount rate, the table in this paper should speak for itself. When one is managing any renewable resource, discounting should be viewed with a suspicious eye.