

A METHODOLOGY FOR EVALUATING THE BENEFITS OF MOOSE

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ABSTRACT

Economic values for wildlife resources have often been omitted from value calculations in resource studies. In order to provide a better understanding of economic values, a methodology for estimating the main components of the value of the benefits a hunted species is presented and illustrated by applying the valuation techniques to moose in Manitoba. The main sources of economic value for which estimates can be derived, include resident hunting, non-resident hunter expenditure and subsistence hunting. Also discussed is the estimation of non-consumptive value and the calculation of incomes and employment supported by resident hunter expenditure.

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The objective of this paper is to present a methodology for estimating the economic value of a hunted big game species in a province or state and to illustrate the use of the methodology by applying it to moose hunting in Manitoba.

It should be noted that the values in this paper represent the benefits derived by a state or province from activities involving the utilization of moose. The main objective of engaging in such a calculation is to make it possible to compare the benefits with the costs incurred by various agencies in managing the resource. The total value calculated according to this approach, therefore, represents a gross value to society. To derive the net value, it would be necessary to deduct the amount expended by agencies engaged in the management or enhancement of the resource.

The estimation of economic benefits for wildlife species involves a number of difficulties. One set of problems derives from the fact that hunting is a non-market activity. Because market data are unavailable, survey techniques must be employed to estimate values. In the case of other components of hunting value, inference and assumption must be employed to calculate estimates; although these techniques do not result in as high a degree of precision as is achievable in some disciplines, they are the only means available upon which to base estimates of value in this difficult area.

It is hoped that the methodology outlined in this paper will assist persons involved in the management of wildlife populations to acquire a better understanding of the components of economic value and even to apply some of the methods presented in their own jurisdictions to derive value estimates.

METHODS AND RESULTS

There are, for most hunted big game species, four major sources of economic value for which magnitudes can be estimated:

- 1) Resident hunting
- 2) Non-resident hunter expenditure
- 3) Subsistence hunting
- 4) Non-consumptive wildlife activities

Before discussing the sources of economic value, it should be noted that the value which will be derived represents the net, rather than the gross value of the resource. The net value reflects the deduction of all costs incurred in realizing the gross value. In the case of resident moose hunting, for example, the gross value of the resource represents the total value of hunting to resident hunters. The net value excludes all expenses incurred by hunters in pursuing the hunt. The net value so derived, is the figure which should be used in benefit-cost analysis and in the evaluation of programs and projects. Although there are occasions when use of the gross value estimate is appropriate, the net value is by far the most useful of the two magnitudes.

Resident Hunting

Most persons who hunt engage in an experience which is worth more to them than the funds which they must expend in pursuing that activity. The amount by which the value of a commodity realized by a consumer, exceeds the cost to him of obtaining it, is referred to as the "consumer surplus". For a discussion of consumer surplus, see Currie (1971). Many hunters realize a consumer surplus; often that surplus

exceeds by a substantial percentage the costs incurred in hunting. In general, the most feasible method of estimating the consumer surplus is to conduct a willingness-to-pay survey of hunters. See for example, Davis (1983), Hammack and Brown (1964) and Langford (1978). In the survey, a sample of hunters is selected and the respondents are asked how much they would be willing to spend on the hunt, in addition to the amount which they actually did spend. The difference constitutes the consumer surplus realized by the hunters. The mean consumer surplus can be calculated for the sample, then extrapolated to the total hunting population to derive the value of the consumer surplus for the entire province or state.

The consumer surplus should be determined by three questions. The first question asks how much was spent during some specific period in each of a number of specified cost categories. This question ensures that the respondent considers carefully the amount which he spent. The second questions asks if the respondent would have hunted even if his costs had been higher. The third question, which is posed only if the answer to the second one was positive, asks how much more the respondent would have been willing to spend to hunt during the period.

The wording of the survey questionnaire is rather important. A considerable amount of attention and debate has been devoted to the wording of willingness-to-pay questions. For a discussion, see Cocheba (1976). The survey by Statistics Canada (1981) was constructed with a great degree of care. The wording which that survey employed for large mammals appeared on page 7. It was as follows:

71. How much did you spend on Transportation to hunt large mammals in 1981?



72. How much did you spend on accommodation to hunt large mammals in 1981?
73. How much did you spend on food while hunting large mammals in 1981?
74. In 1981, how much did you spend on equipment used primarily for hunting large mammals in 1981?
75. How much did you spend on ammunition, repairs and other items for hunting large mammals in 1981?

NOTE: Definitions were provided for each expenditure category.

76. Would you still have hunted large mammals if your costs had been more?

Yes No

77. How much more would you have spent before deciding not to hunt large mammals in 1981?

\$ 1 to \$ 49	\$200 to \$399
\$ 50 to \$ 99	\$400 to \$799
\$100 to \$199	\$800 or more

It is recommended that similar wording be used with, of course, appropriate changes for species, in questionnaires aimed at determining hunter willingness-to-pay. In the moose hunter survey conducted in Manitoba, the original intention was to employ the formulation used in Statistics Canada (1981). However, since moose hunting license fees have undergone substantial increases in recent years, it was felt that the recommended wording would be interpreted by Manitoba hunters as an attempt to determine how much more hunters would be willing to pay in license fees. For that reason, the willingness-to-pay question was formulated in percentage terms instead of in dollar terms. The willingness-to-pay questions in the Manitoba survey were as follows:

3. Please estimate how much money you spent moose hunting in 1984 in each of the following categories:

- Transportation (include gas, oil, car rentals, aircraft costs, etc.)
- Accommodation (include cabin, lodges, motels, campgrounds)
- Food (include groceries, meals and beverages)
- Equipment (include equipment which was purchased primarily for hunting, such as guns and accessories, calls, camping gear, trailers, all-terrain vehicles, etc.)
- Other (ammunition, repairs, hunting clothing, guiding fees, etc.)

4. Would you still have hunted moose in 1984 if your total costs had been higher?

Yes No

5. If your answer to Question #4 was "yes", based on the above total expenditure, indicate what additional percentage you would have spent before deciding not to hunt in 1984?

1 to 20% more	61 to 80% more
21 to 40% more	81 to 100% more
41 to 60% more	Over 100% more

There is little doubt that the formulation in the Manitoba survey is inferior to the wording employed by Statistics Canada (1981). One of the more obvious problems with the percentage formulation is that a number of hunters can be expected to err in calculating their willingness-to-pay in percentage terms.

Several points should be noted regarding the setting up of a survey:

- Mail surveys can be relatively economical. If stratification is not necessary, confidence levels of 95% within ± 10 percentage points can be achieved with approximately 100

responses (Mendenhall.1979, p. 244). The cost of tabulation and postage should therefore be relatively modest.

2. When conducting a survey, wildlife managers will often want to obtain information other than hunter willingness-to-pay. Although other questions can easily be included, it is advisable to keep the survey as brief as possible with instructions and questions limited to a single page.
3. It may be necessary to divide the hunter population into two or more segments. The greater the number of such divisions, of course, the greater the cost of the survey. In Manitoba, there are two groups of moose hunters: those who purchased general licences and those who acquired special licences. The latter entitle the holders to hunt in areas which are in high demand and they are obtained through a draw. The Manitoba survey was, therefore, stratified accordingly.

Since the Manitoba survey was stratified to reflect general and special licences, two sets of tabulations were carried out.

The results for the general licences were based on 88 responses instead of the 100 or more which were originally planned, because of unavoidable delays in the production and mailing of the survey questionnaires. The tabulations, which are expressed in terms of Canadian currency, resulted in a mean consumer surplus of \$178. For a proportion, with 88 responses, a 95% confidence interval around the estimate of that proportion, should be within $\pm 10.5\%$ of the proportion. (Mendenhall. 1979, p.240). However, for the mean consumer surplus of \$178, the

confidence interval was $\pm \$112$, which is rather substantial. The wide confidence interval is indicative of a high degree of variability in the responses.

A comparison with the results of the Statistics Canada survey may be useful. That survey resulted in a mean consumer surplus of \$197 (with a confidence interval of $\pm \$40$) for Manitobans who hunted big game in 1981. The equivalent amount in 1984 dollars is \$234. The implication of the Statistics Canada survey result is that the \$178 mean calculated from the Manitoba survey is low. One of the more plausible reasons for the low mean is downward bias in the survey responses. This may have resulted from game-playing by respondents who interpreted the survey as a method employed by government to determine whether higher hunting license fees would be acceptable. This conclusion is supported by the fact that moose hunting license fees have undergone substantial increases in recent years.

6,140 hunters purchased general moose hunting licences in 1984. Application of the \$178 estimated mean, resulted in a total consumer surplus for general licence holders of \$1,092,900.

The results for the special licences were based on 100 responses. The mean consumer surplus was \$188 and the confidence interval was ± 105 . Two observations appear to be in order. Firstly, it is to be expected that the willingness to pay of the special licencees would exceed that of the general licencees since the demand for special licences exceeds the supply and allocation is determined by a draw. Secondly, the confidence interval for the special licencees is almost as wide as for the general licencees. On the basis of the mean of \$188, the total consumer surplus for the 1,671 special licencees amounted to \$314,100.

Summing the values for the general and special licences resulted in a total consumer surplus for all moose hunters in Manitoba of \$1,407,000 in 1984.

An additional component of the value of resident hunting, consists of the revenues from the sale of hunting licences. This component of value can, of course, be readily obtained from the licence sales unit of any province or state or, if the final figures sales figure is not available for the year in which the survey is conducted, it can usually be estimated on the basis of the sales of the previous year. In Manitoba, 1984 moose licence revenues were estimated at \$195,000.

One common source of misunderstanding in the area of wildlife benefits, relates to expenditures by resident hunters. While such expenditure supports employment and incomes within the boundaries of the jurisdiction, it is generally assumed that such spending does not constitute an economic benefit since, if hunting were eliminated, most of that money would probably be spent on other activities or goods within the state or province, thereby supporting jobs and incomes in those areas. In this connection, the following statement from page 29 of Pearse (1969) is illuminating:

"In contrast to the procedure followed in Chapter 2 in dealing with benefits of non-resident fishing, no benefits are ascribed to the expenditures of residents on goods and services purchased in pursuit of fishing. This is because the purpose has been to establish the net gain to the Province as a whole: The benefit of non-resident spending on goods and services calculated in Chapter 2 is the estimated increase in incomes that

the Province would not have enjoyed if the Kootenay Lake fishery had not drawn these visitors to the Province. However, it can reasonably be assumed that residents would spend roughly the same amount on goods and services in the Province whether they fished at Kootenay Lake or not. Their spending would no doubt be on different things and in different places, but there is no reason to believe that the income so generated would be either greater or less."

The foregoing statement applies to a specific fishery in a province. With regard to hunting throughout a state or province, the question is whether or not expenditure within the jurisdiction would be reduced significantly if hunting were not available. In the case of moose hunting in Manitoba it was assumed that expenditure would be reduced by very little. As noted above, this assumption rests on the argument that most of the money which Manitoba moose hunters would have spent hunting moose, would be spent on other activities or commodities within the province. While this assumption is not entirely satisfactory, it would appear to be preferable to any alternative assumption and certainly it is the one most widely adopted in the calculation of fishing and wildlife benefits.

A further point worth noting is that incomes supported by hunter expenditure whether by residents or non-residents, do not constitute net benefits to the jurisdiction. In measuring net benefits, it is necessary to deduct from the gross value of expenditures, the costs incurred in providing the goods and services purchased.

Non-Resident Hunting Expenditure

The consumer surplus realized by non-resident hunters is not considered to be a benefit. It is only the benefits which result from non-resident expenditure which are considered to constitute a benefit to a province or state. For many jurisdictions and species, this amount will be small relative to the other components of value. In such cases a fairly rough set of calculations may be adequate, since even a substantial error is not likely to have a large impact on the total value for all components.

The net benefits resulting from non-resident expenditure are comprised of business profits (i.e., revenues less costs) and government revenues resulting from sales taxes, taxes on gasoline, taxes and profits on liquor sales and fees from hunting licences. The magnitude of these items (except for licence fees) was calculated for non-resident fishermen's expenditure in British Columbia in 1976-77. The estimate, which is presented in Quadra (1977) amounted to approximately 10.5% of non-resident spending. Although derived for a single Canadian province in the mid-1970's, that estimate is probably not too different from today's percentage magnitudes for most provinces. Therefore, in the absence of more precise figures, an amount equal to 10-11% of non-resident hunting expenditures may be used.

Unless specific information is available, it will be necessary to derive an estimate of non-resident hunting expenditure. If a high degree of precision is required, a survey of non-resident hunters will be necessary. However, if a crude estimate will suffice, less precise data is often available from other sources. Per-diem food, accommodation and transportation spending estimates for tourists are often available from

provincial or state tourism departments. These figures can be applied to the estimated number of non-resident hunter days to calculate total non-resident hunter expenditures. As indicated above, the net economic benefits can be roughly estimated for most provinces, at 10-11% of those expenditures.

The revenue from non-resident licence sales is available in each jurisdiction and can be added to the value of the benefit derived from other non-resident expenditure to obtain the total net benefit from hunting by non-residents.

In Manitoba, the data available for non-resident moose hunting expenditure is unusually precise, since alien non-resident hunters are required to engage a lodge or outfitter and those operators report their charges and the number of non-resident hunter days provided. (The number of non-resident Canadian hunters was negligible.) In addition, a comprehensive survey of Manitoba lodges and outfitters resulted in an estimate of net income as a percentage of gross revenues. That estimate, which amounted to 22%, was applied to the gross revenues received from non-resident moose hunters. The net income so derived, amounted to \$36,000. No attempt was made to calculate the magnitude of the other expenditure-related items since the amounts would have been negligible.

The revenues from non-resident alien licence sales amounted to almost \$21,000. That amount, when added to the estimated net income of outfitters, resulted in a total benefit for Manitoba of \$57,000.

Subsistence

Reliable information on subsistence hunting is unavailable in most jurisdictions and surveys are impractical. It is therefore necessary to derive estimates on the basis of assumptions which reflect the best guesses of those professionals who are the most knowledgeable.

The major portion of the value of subsistence hunting derives from the edible meat which is obtained from the hunt. In order to calculate that value, a series of estimates must be made. The number of animals harvested must be estimated along with the portion consisting of bulls, cows and calves. The usable amount of meat per carcass must be estimated for each of the three categories and the weighted average amount per carcass calculated. The price per kilogram for a side of beef must be obtained from local meat markets and applied to the average amount of meat per carcass. That figure in turn is multiplied by the number of animals harvested to derive the gross value of the harvest.

For Manitoba, the subsistence harvest was estimated at 3,000 animals with bulls, cows and calves accounting for 25%, 60% and 15% respectively. The respective usable meat poundages were estimated at 167 kg, 156 kg, and 74 kg, and the weighted average per carcass amounted to 146 kg. The price of beef was \$5.29 per kg. Applying that price to the average carcass weight for 3,000 animals resulted in a gross value for the harvest of \$2,317,000.

The next step in the estimation process is the derivation of the costs associated with the subsistence harvest. Although this step is sometimes omitted, it should always be carried out. Here, a number of more or less arbitrary assumptions have to be made. The procedure can

best be illustrated by following an account of the process undertaken for the Manitoba subsistence hunt.

- The chief mode of transportation employed is motor vehicle. The calculation of the transportation cost was based on an assumed round-trip distance of 80 km, an operating cost of \$.20 per km and four trips per animal harvested. The cost per animal amounted to \$64.
- The ammunition cost was based on the assumption of three shots per animal harvested at a cost of \$.90 per shell for a cost per animal of \$2.70.
- The rifle was assumed to represent most of the equipment cost. The average cost of a rifle was estimated at \$400, and the useful life 10 years for an annual depreciation figure of \$40. It was further assumed that each rifle was used to harvest 2 animals per year. The cost per animal, therefore, amounted to \$20.
- Additional expenditures on equipment and miscellaneous items were assumed to amount to \$20 per animal.
- The total cost per animal amounted to \$106.70. Applying that amount to the 3,000 animals harvested resulted in a total cost of \$320,000.

The final step in the calculation of the net value is to subtract the estimated total cost from the gross meat value. The resultant figure of \$1,997,000 represents the net value of the subsistence hunt in Manitoba.

It should be possible to carry out a similar calculation with, of course, appropriate changes in the assumptions and estimates, for many

states and provinces and for other species which are hunted for subsistence.

One of the questions which is a legitimate subject of debate in the calculation of the value of subsistence hunting is whether the cost calculation should include a value for hunter time. If the time devoted to subsistence hunting would have been spent on remunerated employment and if the enjoyment derived by the hunter does not fully offset the money income foregone, then some time value should be included in the cost of the hunt. Such an estimate, if it is made, should reflect the wage rate and the unemployment rate of subsistence hunters. In calculating the value for Manitoba, the decision was taken not to include a value for hunter time because of the high unemployment rates in native communities and because of the traditional values attached to the hunting and fishing activities of native people.

Non-consumptive Value

There are several types of non-consumptive value. There are the so-called "option" or "existence" values which represent the value attached to wildlife by persons who do not pursue any wildlife activities. The other source of non-consumptive value represents the value derived from non-consumptive activities which are related to wildlife. It is the latter source of value which is discussed in this section. No attempt will be made in this paper to estimate the option or existence values.

The non-consumptive value is derived from activities such as viewing, photographing, feeding, studying and identifying wildlife. As

in the case of hunting, the value of such activities can be estimated by means of survey techniques aimed at determining the amount which participants would be willing to pay - over and above what they actually did pay - to pursue those activities. However, in the case of non-consumptive pursuits, the universe surveyed is usually the general population, whereas in the case of willingness-to-pay surveys of hunters, the universe consists only of hunters. This is because complete lists of hunters are usually available, whereas such information is seldom available for non-consumptive users.

Willingness-to-pay surveys of non-consumptive users tend to be aimed at determining the consumer surplus derived from all wildlife species, some of which are not hunted. It is difficult to derive from such survey data the non-consumptive values for any specific hunted species. However, bureaucratic demands are sometimes made to include estimates of the non-consumptive value of such species along with the consumptive values. If a non-consumptive estimate is mandatory, the best approach is probably to base the estimate on the non-consumptive survey data which are most relevant to the province or state.

In the case of moose in Manitoba, the most relevant data consisted of the results of the survey by Statistics Canada (1981). Those results included estimates for Manitoba of the consumer surplus derived from trips for which the primary purpose was the pursuit of non-consumptive wildlife activities. That surplus was estimated at \$14.3 million. According to estimates resulting from the survey, the consumer surplus for all hunting in Manitoba amounted to \$22.2 million. Thus, the surplus resulting from non-consumptive wildlife trips amounted to 64% of the surplus for hunting. That percentage can be applied to the estimated consumer surplus for a hunted species to derive a very rough estimate of



the non-consumptive value. The application of that approach to Manitoba resulted in an estimated non-consumptive value of \$900,000. On an intuitive basis, that amount appears to be somewhat excessive, considering that moose in the wild are mainly located at a considerable distance from large population centres and are not seen with great frequency when travelling on the main roads.

It should be emphasized that this approach to the estimation of non-consumptive value should be used only if it is mandatory that an estimate be made and if no data of greater relevance is available. It is probably better to omit any estimate of the non-consumptive value of a species than to rely on an estimate of the type outlined herein. Because of the difficulties inherent in attempts to produce useful estimates of non-consumptive values for hunted species, such estimates are avoided in most studies.

Other Economic Calculations

The components of economic value for a hunted species have been discussed in the foregoing sections. There is one type of calculation which is often included in studies of economic value. That calculation involves estimates of the incomes and employment which are supported by the expenditure of resident hunters. It was stated in an earlier section that while such spending does support incomes and employment, it does not constitute a net economic benefit since, if hunting were eliminated, most of the money would probably be spent on other activities or goods within the state or province, thereby continuing to support income and employment within the jurisdiction.

Since the jobs and incomes supported by resident hunter expenditure cannot be considered to constitute a net benefit to the jurisdiction, one can only speculate on the reasons for including such calculations in studies dealing with the economic benefits of hunting. One possible reason is that such calculations perform a descriptive function in indicating the pattern of economic inter-relationships which exist. Another, is the propagandistic value of such calculations; the value of the incomes and employment tend to be high relative to the consumer surplus values, particularly when the indirect effects are included.

In order to calculate the incomes and jobs supported by resident hunting expenditure for a given jurisdiction, it is necessary to have access to a set of input-output tables for that jurisdiction or at least for the region in which the jurisdiction is located. Such tables are available for a number of Canadian provinces including Manitoba.

Total resident moose hunter expenditures in Manitoba as estimated from the survey results were as follows:

Transportation	\$1,082,000
Accommodation	135,000
Food	618,000
Equipment	2,334,000
Other	439,000
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TOTAL	\$4,608,000
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The expenditures in each of the categories above were allocated to the appropriate industry groups of the input-output table and the industry coefficients were applied to the expenditures figures. The results, which included the indirect and induced effects of the expenditure amounts, indicated that the value of Gross Domestic Product

ported by resident moose hunter expenditure amounted to \$3,853,000. The Gross Domestic Product is a measure of the value of all incomes earned in the Province, as well as a measure of the value of output. The labour income supported by resident hunter expenditure amounted to \$2,708,000 and total employment was estimated at 161.

A similar set of calculations can be done for non-resident hunter expenditures and the results added to those calculated for resident spending. This step was omitted for Manitoba since the effects of non-resident spending were not significant in relation to the effects of resident hunter expenditure.

Again, it should be emphasized that the calculation of incomes and employment supported by resident hunter expenditure are not a necessary part of a study of the economic value of a hunted species since they do not constitute a net benefit to the province or state. These calculations can therefore be omitted from a set of value calculations on theoretical grounds alone. In addition, such estimates require some economics expertise and the requisite input-output data may not be available in all jurisdictions.

SUMMARY OF VALUES

Each value category for a hunted species is listed below along with the values estimated for moose hunting in Manitoba in 1984.

Consumer surplus realized by resident hunters	\$1,407,000	
Resident hunter licence fees	\$ 195,000	
		\$1,602,000
Benefits from non-resident expenditures	\$ 36,000	
Non-resident hunting licence fees	\$ 21,000	
		\$ 57,000
Value of sustenance hunting		1,997,000
Total Value		\$3,656,000

A method for estimating the non-consumptive value of hunted species, resulted in a value of \$900,000 for Manitoba. Such methods should only be used if an estimate is absolutely mandatory and if adequate data are not available.

The income and employment supported by resident hunter expenditure cannot be considered a net benefit of hunting but rather a set of descriptive magnitudes. In Manitoba, the income and employment supported by moose hunting expenditure (including multiplier effects) were as follows:

Gross Domestic Product (Value of Income)	\$3,853,000
Labour Income	\$2,708,000
Employment	161

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