Components of the Economic Value of Wildlife: An Alberta Case Study

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Wildlife resources and the services they provide are not typically traded in markets. In spite of a high regard for wildlife resources by individuals, the value of wildlife is often assigned a low or zero price in economic analyses that include trade offs with industrial developments. A partial reason for this anomaly is the lack of market prices for the various kinds of uses or services derived directly from wildlife, including the value of wildlife preservation. In this paper methods of determining values for wildlife resources are discussed. The role of these values in benefits cost analysis is addressed. An empirical analysis of components of wildlife value from an Alberta case study is presented. The analysis includes both use and non-use values. The results suggest that non-use values, or preservation values, represent a large component of the value of wildlife.

Key Words: Wildlife values, nonmarket value, contingent valuation, economic analysis, benefit-cost analysis.

Within the last decade, concern for the environment has risen to the top of the agenda of national and international issues. In Canada, concern for wildlife is high among the various environmental issues (Federal-Provincial Wildlife Conference 1983). In Alberta, 87% of the population over the age of 15 state that maintaining abundant wildlife populations is important (Filion et al. 1989). In spite of this high regard for wildlife resources, the value of wildlife is often assigned a low or zero price in economic analyses that include trade offs with industrial developments. A partial reason for this anomaly is the lack of market prices for the various kinds of uses or services derived directly from wildlife. There are non-use or preservation values associated with wildlife that are nonmarket in character also. Consequently, decisions have been made in the past in which the contribution of wildlife has been under-represented. This has sometimes resulted in decisions which have posed adverse implications for the sustainability of wildlife populations.

The purpose of this paper is to outline the components of wildlife values, an evaluation framework, methods of valuation, and recent empirical results. The empirical focus is on use values derived from consumptive use (e.g., hunting), non-consumptive use (e.g., birdwatching) and on non-use (e.g., preservation) associated with wildlife in Alberta. There are other potential categories of use that have value. At the present time empirical information on these is lacking.

Society is capable of providing an increasing volume and array of human-made goods and services, but is largely incapable of creating natural environments including wildlife and wildlife habitat. The reduction in natural environments results in increased values (through increased scarcity) for those natural amenities, including wildlife. At the same time, however, demand levels for wildlife and other natural environmental components and systems have increased. If we as a society are to make informed choices about how much of a natural environment, including wildlife, we wish to maintain or preserve, and how much we wish to irreversibly alter, some effort must be made to supplement market value information with nonmarket value information.

Wildlife Values

In order to assess the economic and social importance of wildlife, an understanding of the components of wildlife value is essential. Note that we are generally interested in the value of wildlife-related services rather that the value of an individual animal or species. A potential framework for value is identified in Figure 1. There are two broad value categories, use and non-use. Use values are more readily understood and have been the primary focus for economic evaluation during the past three decades.

Use values can be divided into direct and indirect use values. Direct use values are further subdivided into consumptive and non-consumptive use values. Consumptive-use values are related to activities such as recreational hunting and commercial harvest including ranching operations. Consumptive use has an impact on wildlife populations; it removes individual animals from their natural environments. Non-consumptive use values, on the other hand, do not affect wildlife populations directly. They are associated with such activities as wildlife viewing and study. The importance of nonconsumptive use of wildlife is only now being

recognized on a par with consumptive uses (e.g., Butler 1983). Indirect use values arise through the vicarious enjoyment of wildlife through published material, media documentaries and the like. There are no empirical data in Alberta indicating the importance of these values. Consequently, indirect use values are not part of the focus of this paper.

Non-use values are based on either potential future consumption or current satisfaction from the knowledge that wildlife resources exist. They can be broken into three categories, existence, bequest and option values. Existence value is a value assigned to the knowledge that a resource such as a wildlife species exists, regardless of whether or not the individual uses or consumes the resource today or will wish to do so in the future. Individual donations to wildlife funds, societies, and preservation groups are evidence of existence values.

Bequest value, on the other hand, is based on the potential use of the resource by the individual's descendants. In other words, people are willing to pay to preserve a resource or resource system for their children or grandchildren. Finally, option value is a value derived from the fact that future supply and/or demand for the resource are uncertain. It will vary depending on the values for the resource or activity and on the risk preferences of individuals. While a part of economic value, option value may be negative, depending on risk-taking behavior and preferences over wildlife services on the part of each individual.

The components of wildlife value identified here have been subjected to considerable measurement efforts by economists. Direct-use values have been most commonly measured during the last three decades, and rapid development of appropriate measurement techniques has taken place during this time. Efforts to measure indirect and non-use values are very recent and development of appropriate techniques is still underway. This topic is addressed below in the section on methods.

Benefit Cost and Impact Analysis

Unlike market goods and services, the demand signals from consumers (recreationists) for wildlife services as well as non-use components are not readily conveyed to resource-use managers and other decision makers due to the absence of defined markets and prices. As indicated earlier, outdoor recreation and other environmental interests must find other means of registering nonmarket values through various organizations including wilderness and parks associations, fish and game associations, and preservation groups. These groups play an important role as a counterbalance to competing private commercial interests that may displace or alter natural environments. Generally, the allocation of resources to industry are arrived at through public decision making without the knowledge of measured economic values associated with non-commercial resource uses. Wildlife and other environmental interests cannot afford to ignore such explicit values. Furthermore, public sector agencies must]he concept of *economic efficiency* is at the center of this analysis. It has to do with whether or not the benefits are greater than costs and if so, by how much. If, for example, a decision is made to displace or alter a natural area in favor of resource commodity extraction, what does society gain and what does society lose? Are the gains sufficient to more than offset the losses; that is, are the net gains or net benefits positive? Generally, the greater the net benefits the more economically efficient the resource allocation decision. Choosing the resource use pattern that renders the greatest net benefit to society may be an appropriate criterion in resource use decisions. However, resource use values, including wildlife values, must be known if we are to quantify benefits and costs. Part of the cost of choosing any resource use pattern is the net benefits foregone from displaced uses. Part of the social costs of economic growth have been the loss of social benefits associated with displaced natural areas. As indicated above, these costs have not been fully recognized historically, in part because estimates of (nonmarket) value have been lacking. Efforts to increase our social well-being can be facilitated by increased attention to issues of economic efficiency in resource use tradeoffs involving nonmarket values. Determination of these values, wherever possible, is essential.

Associated with the concept of efficiency is the concept of *equity*, or fairness, in which questions about the incidence of benefits and costs among specific individuals or groups in society are addressed. Who gains and who loses from changes in the use of our environment? For example, a reduction in amenity services including wildlife, from resource extraction or waste assimilation results in losses to naturalists, outdoor recreationists, and others who value these resources. The gains elsewhere in society from the alternative use may more than offset the losses and therefore justify the environmental alteration as an efficient allocation of resources. But is such a loss tolerable? The collective values of society may lead to the answer "no" once a certain point is reached in the reduction of natural environments. Thus the most acceptable resource use pattern, on efficiency grounds, may be less than desirable on equity grounds.

Equity judgments are societal decisions revealed largely through the political process and made explicit through formation and implementation of public policy. Economic efficiency considerations can be an important part of that process but will be constrained by equity or fairness considerations. However, environmental resource-use considerations on equity grounds can be served by the ex-

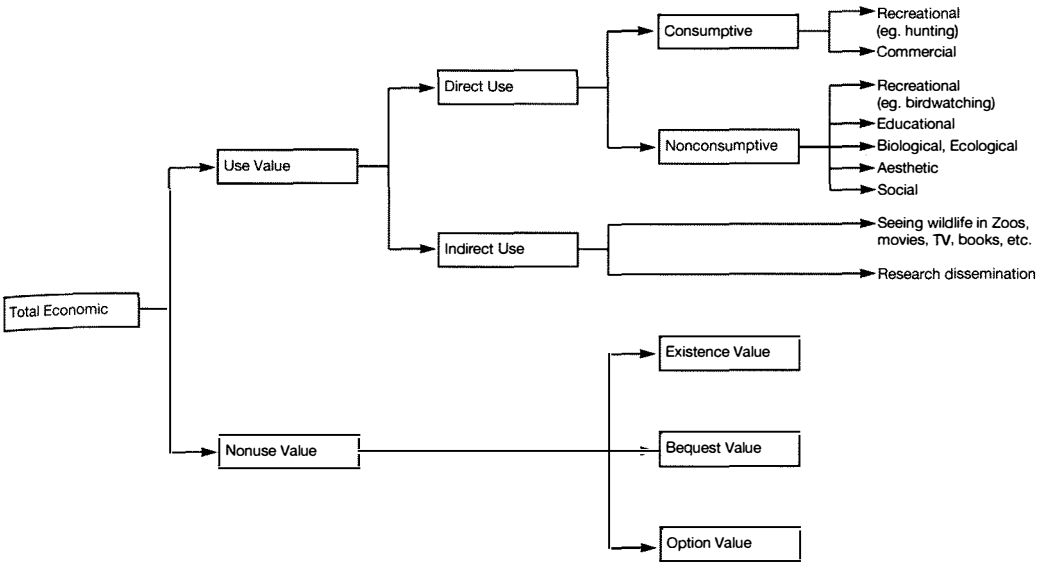

FIGURE 1. Components of the total value of wildlife.

amination of nonmarket values and their distribution throughout society. Benefit-cost analysis, therefore, is useful not only in arriving at net benefits (benefits less costs) but in tracking who gains and who loses.

Any economic activity has associated with it local or regional impact. Wildlife-related expenditures are at the center of impact analysis involving wildlife considerations. Such analysis focuses on inter-sectoral or inter-regional transfers and is distinct from benefit cost analysis which focuses on economic efficiency and equity through emphasis on wildlife values and management/enforcement costs. In essence, the wildlife resources generate both economic values and expenditures. Unfortunately, many individuals consider expenditures to represent value. This is not the case. Individuals who live adjacent to prime wildlife habitat will spend little in travel and lodging to enjoy the resource. Their personal values of the wildlife resource, however, may be many times greater than the value held by an individual who incurs great expense in travelling to enjoy the resource. While expenditures are not appropriate as a measure of value, they are important for determining the regional economic impact of activities involving wildlife resources.

Regional economic impact is a measure of the generation of economic activity in a region which is stimulated by the injection of external funds. Several businesses within a small town near a wilderness area, for example, may benefit from the money brought in by wildlife oriented tourists. The income generated in these businesses is spread throughout the community. It must be made clear, however, that these economic impacts are important on a regional scale, and are likely not useful on a provincial or national level. If an area is closed to hunting, individuals will still spend their money, either by hunting in other places or by spending it in some other activity (e.g., professional sporting events).

The economic value for the resource, however, always remains with the resource and while expenditures are not appropriate measures of value per se, they often provide a mechanism by which value can be inferred and subsequently used in benefit cost analysis. This approach to valuation is discussed below in the section on methods.

Methods

Valuation Methods

In attempting to derive values of nonmarket goods for use in benefit cost analysis economists have developed two different approaches. The first approach, the indirect or inferential approach, uses actual market observations to infer a value for the nonmarket good. The travel cost model, originally conceived by Hotelling (1947) and recreated by Clawson (1959), is based on an examination of the quantity of trips to a recreation site as costs to reach the site increase. Using cross-sectional data, estimates of how recreationists respond to price can be developed in the same manner as a demand curve for any traditionally priced good. The "price" of the recreation trip is the travel (and associated variable) cost. The demand curve for trips to the site can then be used to determine the "willingness to pay" for trips to the site. The latter is a measure of the economic value of the site.

A number of assumptions are made in the inferential approach. Details on these assumptions and their implications can be found in Fletcher et al. (1990). The inferential approach has been used to derive values for sites, for quality changes in recreation sites and for various management changes. However, valuation in this case requires that market data on recreational use be available. Therefore, this approach cannot be used to value goods or services which do not involve some market expenditure on travel or other goods. For example, the inferential approach cannot be used to estimate the existence or preservation value of wildlife.

A second approach, the direct or contingent valuation approach, attempts to place a value on goods contingent on there being a market price for the goods or service. This technique rests on two assumptions. First, the respondent understands the goods or service being described and can place a value on it. Second, the individual does not misrepresent this value. These assumptions can fail for a number of reasons. For example, if the individual is not familiar with the goods or cannot imagine paying for the goods in the manner described then the results are of limited value. Indeed, in such occasions there may be a tendency for non-response. Also, if an individual sees the valuation experiment as an opportunity to behave strategically, then the valuation will be biased. Considerable research on these assumptions suggests that careful design in the survey procedure can limit the difficulties due to misunderstanding the goods or service, and that strategic behavior tends to be quite infrequent (*see* Mitchell and Carson 1989).

A particular aspect of contingent valuation research hinges on the fact that individuals do not actually pay the amount they state as their willingness to pay. This characteristic has lead to a number of studies of individual behavior in response to hypothetical questions. The landmark study in this literature is Bishop and Heberlein (1979). These authors compared hypothetical valuation question results with actual cash outlays for goose hunting permits. There was no significant difference between the two values. The findings do suggest that a properly structured contingent valuation study can reveal a value which is not different from the amount that people would actually provide in a market. Naturally, as one deviates from the assumptions required for the contingent valuation method, the chances of hypothetical results actually representing market outlays decreases.

The purpose of this study is to determine the value that individuals place on various aspects of wildlife. In particular, the value individuals place on wildlife preservation will be examined using a contingent valuation question. Use values of wildlife will be obtained from a similar contingent valuation procedure used in the National Survey of the Value of Wildlife to Canadians (Filion et al. 1989).

Preservation Value: The Household Survey

Preservation values, as defined above, are values that individuals place on the resource independent of use values. In an attempt to derive such values, a random sample of Alberta households were asked how much they would be willing to pay, into a trust fund, for the preservation of wildlife. The details of this mail survey are presented below.

A random sample of 2400 Alberta households was drawn from telephone directories of Alberta Government Telephones and Edmonton Telephones. Telephone directories provide a mechanism for sampling most households in the province as a large percentage of households are listed. The telephone directories were arranged in random order. Areas with multiple listings were removed from the group to prevent duplication. The sample was chosen by every 300th entry in the telephone directory after a random start.

The survey instrument was pre-tested and received considerable input from Alberta Fish and Wildlife Division staff. Budgetary considerations constrained the number of mailings to one. The response rate, adjusted for undelivered questionnaires was approximately 30%.

A number of potential biases arise in the use of such a mail survey. First, non-response bias is a possible problem. While the response rate to this survey was not high, such a response rate is not unexpected from a single mail wave survey. Non-response bias may be evident in such a survey in the hypothetical valuation questions as individuals who reject the notion of valuation refuse to respond to the survey (Mitchell and Carson 1989). However, the distribution of dollar amounts received in the valuation questions included zero, positive values and refusals in response to the question. While this does not rule out the possibility of non-response bias, it does provide some evidence that response bias has not entirely limited the variability in response to the valuation questions.

Due to the limited budget no second mailings or non-response follow up surveys were possible. However, in other surveys of a similar nature and with similar response rates these authors have found little evidence of non-response bias. A survey of Alberta resident hunters which was carried out at approximately the same time as this household survey was tested for non-response bias using the responses to the second mailing of the surveys as non-respondents to the first mailing. The results revealed no significant differences between the two mailings for a variety of variables. This test is also not a definitive test of response bias but these results may be considered a minimum bound test of response bias.

A second potential response issue is the question of the valuation vehicle. It is possible that response to the valuation question will differ depending on the payment vehicle, ie. taxes or donations. In an attempt to address this issue, half of the sample was presented with a valuation question worded as follows:

The population levels of several species of wildlife in the province are declining due to deteriorating habitat quality and increasing contact with humans. This situation has developed mainly as a result of the increasing use of natural wildlife habitat for various purposes such as timber harvesting, mining, farming, etc.

Suppose a public trust fund was set up to pay for a 5 year wildlife management program to preserve wildlife in the province. This program would include restricting access to selected areas and improving wildlife habitat.

Regardless of whether or not you plan to hunt, watch, feed, photograph or study wildlife, what is the maximum amount of money you would be willing to donate annually to the fund for the preservation of wildlife, if the amount you indicate would be represented by an increase in your income tax?

The question was followed by a "payment card" which contained a sequence of values from $0 to $900 and a line which asked "If higher or other dollar value, please specify."

The other half of the sample was asked the same question with the following words removed:

"if the amount you indicate would be represented by an increase in your income tax."

The first payment vehicle represents a tax payment while the second represents a donation. There was no significant difference in amounts between the tax and donation options, therefore, there is no evidence of vehicle bias. Accordingly, the two samples were pooled before reporting the results.

Use Values: The National Survey

Consumptive and nonconsumptive use values of wildlife were obtained from the National Survey on the Value of Wildlife to Canadians (Filion et al. 1989, 1990). This survey was administered by Statistics Canada as a supplement to its Labour Force survey. Over 10 000 Albertans were contacted by interviewers. The response rate was over 70 percent. The values of hunting and non-consumptive activities were derived using contingent valuation questions. These questions were framed as:

"How much more would you have spent before deciding not to take these outings or trips in 1987?"

The question was followed by a set of dollar categories. For details see Yiptong and Duwors (1990).

Results and Discussion

Using the contingent valuation procedure described above, the preservation value of wildlife was estimated to be $80.92 per household in 1987 (Table 1). As mentioned above, it is difficult to define the specific non-use service(s) that provide benefit to an individual. However, these services include the mere existence of the wildlife resource, the opportunity to pass on use and non-use benefits to future generations, and likely some aspect ensuring the opportunity to engage in future wildlife-related activities. The aggregate value of non-use benefits is estimated to be about $67.7 million dollars per annum.

Table 1 also presents estimates of the economic values of consumptive and non-consumptive use benefits of wildlife in Alberta during 1987. Albertan hunters derived annual benefits of $119.10 to $211.10 per person for hunting various wildlife groups during 1987. An average value for all hunting activities was calculated by multiplying the mean value for each wildlife group by the estimated number of participants, and dividing by the total number of participants. This weighted average value was approximately $165.9 per hunter. These values estimate the monetary magnitude of the benefits Albertans gain from hunting activities. Thus, the provincial wildlife resource provides hunting services worth in aggregate over $53 million dollars per annum.

Another category of use benefits involves non-consumptive uses. These include activities such as bird watching, scientific study, photography, and the simple observation of wildlife in their natural environment. During 1987, Albertans received benefits valued at approximately $162.90 per participant in non-consumptive activities (Table 1). Multiplying this mean by the number of participants results in a total value for non-consumptive use of about $64.5 million. This figure represents the value of the non-consumptive recreational services that Alberta's wildlife provides its citizens.

Considering that the wildlife resource of Alberta is a renewable asset, its value can be approximated by summing the components measured above. This summation results in a total **annual** value of $185.2 million (Table 1). However, as with most assets which generate revenue or benefits on a periodic basis, we have simply measured the annual return from the services the wildlife resource provides Albertans. To translate this annual benefit into the present value of the asset, the annual returns from wildlife in all future time periods must be considered. This is done by discounting the benefits accruing in all but the initial time period. Since the province's wildlife resources are publicly owned, and are presumably managed to provide benefits in perpetuity, discounting involves dividing the annual benefit by the social discount rate (Howe

TABLE 1. Estimate of the economic values of wildlife in Alberta

	$ Values per person per year		Aggregate $ Values (millions)	
	Mean	No. of participants	Annual (1987)	In perpetuity[1]
Preservation Benefits[2]	80.9	836 125	67.7	1354
Hunting[3]				
Waterfowl	171.8	59 730	10.3	206
Other birds	130.0	84 827	11.0	220
Small mammals	119.1	56 738	6.8	136
Large mammals	211.1	118 207	24.9	498
All hunting	165.9		53.0	1060
Non-Consumptive Use[3]	163.0	395 873	64.5	1290
Total Economic Value			185.2	3704

[1]These aggregate values are calculated using an estimated social discount rate of 5%, and are reported in 1987 dollars.
[2]These values were derived from a 1987 Household Survey detailed earlier in the paper.
[3]Values used here were taken from unpublished data from the 1987 *National Survey on the Importance of Wildlife to Canadians*, and from Filion et al. (1990).

1979). The appropriate choice of the discount rate is thus crucial to the estimation of the net present value.

Market or prime interest rates are reflective of three main components: i) the social discount rate; ii) rate of inflation; and iii) lender's risk (Randall 1981). Although numerous studies have attempted to provide insight into the magnitude of the social discount rate none have been definitive. What is clear is that it is less than the market rate and generally ranges from about 3 to 8 percent. Using a rate of 5 percent, generally in the middle of this range, the present value of the services we have measured of the wildlife resource in Alberta is about $3.7 billion (Table 1).

A number of uses or services of the wildlife resource in the province have not been measured in this study; the most notable being commercial uses. Commercial uses include the trapping, guiding and outfitting industries, wild game meat packing and processing services, and game ranching. It is interesting to note that these values are measured by market prices and are the ones most commonly included in analyses of the impact of natural resource industrial expansion on wildlife resources. Although specific values are not readily available for 1987, these commercial uses involve few participants and do not generate significant economic activity relative to the values we have reported above (e.g., Boxall 1986). Other values not included in this study are the value of wildlife services in Alberta to non-residents. Thus the total economic value we report here is a conservative estimate.

Within the total economic value of wildlife it is apparent that non-use values may comprise a significant portion of the total. In our study, preservation benefits represented over a third of the total annual value (Table 1). This is the first published attempt in Canada at measuring these values, and should prompt further research into refining the measurement and use of these values in wildlife management activities. Few studies of the economic value of wildlife-related activities take into account non-use values (e.g., Filion et al. 1990); it is apparent that their omission may represent a significant undervaluation of wildlife resources.

In the United States, economists have attempted to measure non-use values of wildlife resources using contingent valuation techniques, but have focused on individual species. For example, Brookshire et al. (1983) estimated existence values for Grizzly Bears and Bighorn Sheep. Their study utilized a 5-year program scenario similar to ours and revealed mean existence values per citizen in Wyoming of $24.00 and $7.40 for the two species respectively. Bowker and Stoll (1988) found that willingness to pay into a trust fund to ensure the continued existence of the Whooping Crane ranged from $21 to $70 per individual. Boyle and Bishop (1985) measured the total economic value of Bald Eagles in Wisconsin. They found that citizens, depending on their involvement in wildlife-related activities, would donate sums ranging from $18.02 to $75.31 to an endangered species program that would preserve eagles.

Our Alberta estimates of non-use values (Table 1) are somewhat higher than the non-use values described above. However, considering that our estimates involve the provincial wildlife resource and not an individual species, this may not be unexpected.

The nonmarket values we describe in this paper are measurable, and are appropriate for use in investigating the economic efficiency of resource allocations through benefit cost analysis. However, nonmarket values can be used in other ways. For

example, recent research efforts are using nonmarket values in measuring the effects of changes in environmental quality on societal well-being. With respect to wildlife in Alberta, measuring and priorizing alternative wildlife management programs based upon their effect on the benefits received by citizens would be a novel approach. Estimation of nonmarket values enable managers to quantitatively measure the effect of changes in environmental or recreation quality on wildlife and hence on economic benefits or welfare. For example, Coyne and Adamowicz (1990) were able to measure changes in benefits associated with: the closure of any of 10 Bighorn Sheep hunting sites in Alberta, an increase in the population of sheep at these sites, and changes in the congestion of hunters. Findings such as these for all uses of wildlife will assist wildlife managers in planning programs that can best meet the interests of both the wildlife recreationist and those that do not "use" wildlife but still care for it. Provincial government wildlife management agencies purport to act in the best interests of society, and should consider nonmarket values as an important information base for decision making.

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