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Economics in Wildlife Damage Management Studies: Common Problems and Some Solutions

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ABSTRACT: Benefit-cost analysis (BCA) has become a highly useful economic tool to evaluate research and operational efforts in wildlife damage management. At the same time, common problems with BCA can be noted in these studies. These problems include: the absence of present value calculations, the misuse of market vs. non-market valuations, and the improper accounting of benefits and costs. Solutions to these problems are relatively simple but are imperative to the accuracy of the results. This paper outlines a number of common errors in BCA and offers solutions that enhance the use of economics in wildlife damage management studies.

KEY WORDS: benefit-cost analysis, economics, present value, valuation, wildlife damage management

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INTRODUCTION

Efforts to manage wildlife damage are no longer resistant to the forces of supply and demand that drive the actions of private industry. Increased public access to information has increased the influence of special interest groups in wildlife damage management and provided the need for fiscal accountability and justification of management programs. This has provided a need for economic analysis to properly measure the monetary issues associated with wildlife damage management programs.

A number of economic analyses utilize the framework of a benefit-cost analysis (BCA). In general, BCA attempts to consider all of the benefits and costs of a program to society as a whole. BCA is a decision-making tool designed to aid in the efficient allocation of resources (Boardman et al. 1996). BCA in wildlife damage management is most often used ex post to determine if resources were used in an economically efficient manner. The use of this type of analysis provides the framework to examine the economics of most programs; however, several common problems usually arise as a result. In BCA, three of the most common problems are the absence of present value (PV) calculations, the misuse of market vs. non-market values, and the improper accounting of benefits and costs.

PV refers to the value now of one or more payments to be received in the future (Boardman et al. 1996). If a project is extended into future periods, the monetary impacts of each period must be discounted back to the current period and evaluated in the current period. The absence of PV calculations can lead to spurious results and to the acceptance of a project that is economically inefficient. In some cases, the determination of the PV of a project requires assigning values to wildlife species.

Many wildlife species do not have market values; that is, their value is not determined by the interaction between the market supply and demand curves. The value of a wildlife species is often determined through the use of contingent valuation studies to determine existence value, or civil penalties for illegal take, or the amount of revenues garnered by hunting an animal (e.g., Loomis and Walsh 1997). In the case of wildlife, there is rarely an agreed-upon value of each species. This typically requires the use of a range of values when examining the potential impacts.

The most common problem that arises in BCA is the improper accounting of benefits and costs. Often the quantification of costs is easier than the measurement of benefits. In most BCAs, the only costs that are incorporated are those costs that arise from the program (direct); however, these do not cover all the costs that should be considered. Benefits are typically more difficult to quantify and fall into three broad categories: direct, indirect, and intangible.

This paper examines present valuation, non-market values, and benefit-cost estimations. Examples will be provided to illuminate the nature of each of the problems and to help identify when each problem likely exists in a wildlife damage management study. Finally, possible solutions to each of these problems are provided.

ABSENCE OF PRESENT VALUE (PV) CALCULATIONS

The Problem

The question might arise as to why it is necessary to use PV calculations in BCA. The first answer to this question is that it is important to determine the viability of a management program when considered in current dollars. It is important to know that if all the benefits and costs occurred in the current period, that the benefits would exceed the costs. Secondly, given that monetary resources could be invested in a variety of projects offering different yields, it is important to perform a PV calculation to determine if this project offers the "best" expenditure for potentially scarce financial resources.

Consider the following example to illustrate the PV. Suppose that a farmer is suffering damage from deer in the form of crop depredation. In response to this problem, the farmer decides that he will use a fence to protect crops. A local fencing salesman offers a fence that will save $2,000 a year in crop damage, will last for

20 years, and will only cost \$25,000 installed. The farmer does a quick calculation (20 years × \$2,000 = \$40,000) and thinks that this fence will yield \$15,000 in crop damage savings. If the farmer currently has the money in an account that accrues interest at the prevailing interest rate, should he purchase the fence or not? At first glance this may seem like a smart purchase; however, a failure to incorporate the present values of the benefits over time is misleading. As the next section will show, investment in this fence would result in a loss of approximately \$2,000 for the farmer. The result would also differ if the farmer was faced with the option of making payments annually over the lifetime of the fence.

Possible Solutions to PV

The obvious solution to this problem is to use PV calculations any time the benefits and/or costs are evaluated at more than one period in the future. Assume that the farmer is faced with numerous fencing options to mitigate the damage. Each fencing option offers a certain level of protection at a certain price and with varying lifetimes. The farmer should weigh all of these options and make a fencing decision based on whether or not cumulative benefits outweigh the costs.

Consider two different scenarios for the "deer/fence" discussion. Under the first scenario, the farmer must pay the total cost for the fence all in the current period, and in the second scenario the farmer makes payments on the fence over the lifetime of the fence. Further assume that the extent of the damage is known, and that the benefits of the fence will be measured in terms of the dollar amount of crop saved.

Boardman et al. (1996) provide the general form of a net present value (NPV) calculation in which benefits and costs arise over multiple (n) periods. It can be written as:

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t} \qquad (1)$$

where B_t represents the total benefits arising in year t ($t = 0,1,2,\ldots, n$), C_t represents the total costs arising in year t ($t = 0,1,2,\ldots, n$) and i represents the prevailing interest rate compounded per annum. This assumes that the costs and the benefits arise over n number of years.

Under the scenario in which the costs of the project occur immediately ($t = 0$) and all of the benefits occur over the ensuing n years, then equation 1 is rewritten as,

$$NPV = -C_0 + \sum_{t=1}^{n} \frac{B_t}{(1+i)^t} \qquad (2)$$

Under the first scenario where the farmer must pay for the fence all in the current period, equation 2 is appropriate. Entering the appropriate values into equation 2 yields

$$NPV = -\$25{,}000 + \sum_{t=1}^{20} \frac{\$2{,}000}{(1+.06)^t} \qquad (3)$$

Using equation 3 to calculate the present value of the benefits of fencing over 20 years yields a NPV of -\$25,000 + \$22,939.84 = -\$2,060.16. In other words, evaluating this project in current dollars reveals that a loss of approximately \$2,000 will result. Suppose instead that the farmer will be allowed to make equal payments (\$25,000/20 = \$1,250) over the lifetime of the fence. Equation 1 can be rewritten as,

$$NPV = \sum_{t=0}^{20} \frac{\$2000_t - \$1{,}250_t}{(1+.06)^t} \qquad (4)$$

Using equation 4, a calculation of the present value of the benefits and costs of this fencing project over 20 years yields a NPV of \$8,602.44.

This example emphasizes the importance of using PV calculations and the appropriate equation. Under the more likely scenario in which the farmer has to pay for all of the fence costs up front, the proposed fence is too expensive to yield a positive net benefit in PV terms. However, under the second scenario in which the farmer can also spread the payments out over the lifetime of the fence, a positive net benefit results. In either case, the absence of a PV calculation leads to false expectations by the farmer.

MISUSE OF MARKET VS. NON-MARKET VALUES

The Problem

To perform a BCA, it is often necessary to estimate the monetary value of a particular wildlife species. Cairncross (2002), the author of the book *Costing the Earth*, emphasized the importance of determining a value for natural resources with the statement that "In a world where money counts, the land needs value to give it a voice." This idea is also true for wildlife species. "Economics has been called the science of values" and it is often believed that it is the role of economic assessment to determine resource valuation (Blair 1995). The determination of the "value" of wildlife species is inextricably linked to the benefits that wildlife provides to humans, the species assigning value. Accounting for the benefits and costs associated with wildlife is discussed in the next section; however, even when those benefits have been identified, the "value" of benefits still may not be obvious. Shaw (1984) argues that outside of using consumptive values associated with wildlife, the most difficult issue faced when making an economic assessment of "value" is the assessment of the noncommodity values associated with recreation and the assessment of existence values associated with indirect or vicarious uses.

The use of consumptive values to perform a BCA involving wildlife species is common (see Bodenchuk et al. 2003, Shwiff and Merrell 2004). Consumptive values of wildlife are arguably the easiest to identify, and for some big game these values are reported by state game and fish departments. These valuations are determined by such costs as hunting licenses, food, lodging, guide services, and other miscellaneous expenses incurred in the pursuit of consumptive wildlife usage. Shaw (1984) points out that the quality of activities such as hiking, biking, and camping are often enhanced by the presence of wildlife even though these activities are not dependent on the presence of wildlife. He explains that "In these situations, the difficult valuation question concerns what, if any, value should be imputed to wildlife resources from these secondary uses" (Shaw 1984).

In instances when there is no consumptive value of the resource, other methodology must be used to determine "value." The values of endangered or threatened species have been deemed "incalculable" in U.S. Supreme Court Law (Tennessee Valley Authority vs. Hill 1978). In some cases, monetary values can be conservatively estimated by using the costs of captive breeding projects divided by the number of healthy individuals produced or by using civil penalties for illegal kills (Bodenchuk et al. 2003). Engeman et al. (2002) used civil penalties for an illegal take of endangered marine turtles to determine the value of each individual turtle, and Engeman et al. (2003) used captive breeding costs to determine the value of the rare Puerto Rican parrot. Contingent valuation is another means of assigning monetary values to species, if such survey information is available.

Contingent valuation is a method of valuation in which information regarding the benefits and costs of a natural resource are elicited through the use of a survey instrument (e.g., Loomis and Walsh 1997). Through such survey instruments, it is possible to measure individual willingness to pay (WTP) in a hypothetical market for wilderness recreation or natural resources. The survey solicits responses from individuals designed to estimate the maximum amount the individual would be willing to pay for a recreation opportunity or resource if it were available. The payment method can be adjusted to fit the resource in question; examples include higher prices for natural area entrance fees or hunting and fishing licenses, higher trip costs, and higher taxes. Because the scenarios are hypothetical, the validity of the responses to a contingent valuation is unknown. Therefore, the results may not reflect the true WTP, either because people do not have a realistic sense of how much they would pay, or because they have incentives to dishonestly report their WTP (Loomis and Walsh 1997). Also, the use of such survey instruments can become prohibitively expensive.

Given the uncertainty that surrounds the determination of the "value" of wildlife species, it is important to develop a solution that is as dynamic as the problem. Even though a possible solution is offered, it is important to remember that when using economics to determine the "value" of a wildlife species, in almost every case this value does not reflect the total value. This is of course due to the inability to accurately incorporate the nonconsumptive value and the indirect or vicarious value of wildlife.

Possible Solutions to Non-Market Values

The solution to this problem incorporates the idea that most likely the ability to estimate the true "value" of a wildlife species is imprecise and necessarily less than the total value. This simplistic solution to the problem is to use a range of values when performing a BCA that involves wildlife species. These values can incorporate values from different sources, including civil penalties, consumptive values, and contingent valuation. Shwiff and Merrell (2004) performed a BCA of managing coyotes to increase antelope fawn recruitment in Wyoming. The upper and lower bounds of the range of values reflected the maximum and minimum civil penalty values. The second-highest value represented the consumptive value as determined by Wyoming Game and Fish, while the second-lowest value reflected half of the consumptive value. Using a range of values increases the believability and acceptance of benefit-cost estimates because, if the range is appropriately chosen, individuals can usually identify a value that is meaningful to them or at least credible.

A more complex solution would come in the form of a contingent valuation survey. For example, a survey could solicit responses from individuals regarding their willingness to pay to protect certain wildlife species from extinction. To increase the validity of this survey, respondents could additionally be asked if they would be willing to increase their taxes by the stated willingness to pay amount. In most cases, however, willingness to pay surveys are expensive, time consuming, and still will suffer from reliability issues. Therefore, a more applicable solution would be to use a range of reliable values for the analysis.

IMPROPER ACCOUNTING OF BENEFITS AND COSTS

The Problem

A BCA is designed to measure the benefits and costs associated with some type of action. In the case of wildlife damage management studies, the benefits and costs are those associated with a management action designed to mitigate wildlife damage. Most management actions are multifaceted and interdisciplinary; it is specifically the role of economics to determine and "monetize" the benefits and costs involved in the management action to provide a different perspective on project efficiency.

Shwiff and Bodenchuk (2004) outline methodology used to determine direct, spillover or indirect, and intangible benefits associated with predation management. While this paper deals specifically with predation management, it highlights the importance of identifying the numerous benefits associated with managing wildlife species. Benefits can be classified as *direct* benefits, which accrue to the primary recipient of the program; *spillover* or *indirect* benefits, which accrue to secondary entities that were not the intended beneficiaries of the program; and *intangible* benefits that are difficult to quantify but nonetheless exist.

Benefits are often difficult to calculate because in many instances the benefits are dispersed among many, while the costs are concentrated among the few. Shaw (1984) argues that part of the difficulty in addressing the determination of benefits is a result of the difficulty associated with defining wildlife-based products, and the need to identify the users who benefit from these products. Direct benefits are often the most easily identified. Often the direct benefit of a wildlife species is measured by its consumptive value. For example, the benefit of a program designed to enhance the number of a particular wildlife species can be measured by the number of additional animals produced under this program. The determination of the direct benefits of a program is directly tied to the determination of the value of wildlife species, discussed in the previous section. Once a "value" has been determined, the total direct benefit of a program will be measured by the number of animals produced under the program multiplied by the "value."

In BCAs, spillover benefits are rarely incorporated into the analysis and in some cases these can be as large as the direct benefits, but these benefits occur as an indirect intention of the management action. For example, Shwiff and Merrell (2004) examined the spillover benefits to cattle production as a result of coyote management to protect pronghorn antelope in south-central Wyoming. In this analysis, the indirect benefits, while smaller than the direct benefits, offered additional support for the predation management program and additionally emphasized the broad scope of application.

Possible Solutions to Benefit-Cost Accounting

Solutions to this problem are relatively simple. Prior to the analysis, make a list of the all of the benefits and costs that could possibly accrue to the project. Make a separate category for direct, indirect, and intangible. Strategize ways in which as many benefits (costs) as possible can be monetized (assigned dollar values) and incorporated into the analysis. Data collection should then be centered on what is needed for incorporation of the most complete set of benefits (costs). For example, suppose that a study will be undertaken to examine the benefits and costs associated with a predation management project to protect an endangered bird. Further suppose that in the same area where the endangered birds occur, there are also threatened bird species that are affected by the same predators. The process of data collection should involve gathering information on the possible spillover benefits that could accrue to the threatened bird species. Information on changes in the number of threatened species will provide information on the spillover benefits that arise outside of the primary purpose of the management program. This type of data collection provides for a more complete analysis of the benefits and costs of a study with relatively little effort.

SUMMARY

This paper has examined some of the common problems associated with benefit-cost analysis in wildlife damage management studies and offered possible solutions to these problems. These problems include a lack of PV calculations, the misuse of market vs. non-market valuation, and the improper accounting of benefits and costs. The solution to one problem is critical in the solution of the other problems. The implication of failing to include PV calculations is that the current value of a project that has benefits and costs over multiple years may be negative, meaning that the costs outweigh the benefits. Without calculating the PV of a multi-year project, it is impossible to determine if the project has a positive value in today's dollars. In a world where money is used to compare worth, natural resources that are without a monetary value will be hard-pressed to find a sustainable place. This emphasizes the importance of determining and assigning a "value" to the wildlife species that are the subject of BCA. Without a "value" of wildlife species to humans, the benefits of that species cannot be calculated, which obviates the need for PV calculations. Providing accurate solutions to all of these problems ensures that the BCA is as precise as possible.

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