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THE TOTAL VALUE OF WILDLIFE: A CASE STUDY INVOLVING ENDANGERED SPECIES*

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ABSTRACT

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A CASE STUDY INVOLVING ENDANGERED SPECIES

The components of value for a wildlife resource are discussed, with emphasis on existence value. A simple model is proposed and preliminary results of an application to valuing endangered species of wildlife are presented. The empirical results indicate that significant nonuse values may be associated with endangered species of wildlife.

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I. INTRODUCTION

A major issue in environmental cost-benefit analysis is how to conceptualize and estimate the total value of wildlife resources in a consistent and usable manner. This is especially true with cost-benefit calculations for many water resource projects which often have a direct or an indirect effect on wildlife. For example, nearly all water resource projects will have some type of effect on fishery resources. Other types of wildlife, such as waterfowl and nongame birds, can be affected because they depend on water resources as a critical portion of their habitats.

Some practitioners seem to agree that natural resource values, including wildlife values, can be roughly grouped under the general headings of "use" and "intrinsic" values (see Desvousges, Smith and McGivney; and Fisher and Raucher). Use values are associated with the actual use of a resource. Intrinsic values comprise a catch-all category for nonuse values such as option values, existence benefits and bequest values. However, considerable confusion exists regarding the exact distinction between these categories. In addition, the components of the intrinsic value category have not always been clearly defined in a way that is internally consistent.

Partly because of these conceptual problems, the valuation of wildlife resources often focuses on consumptive uses such as hunting and fishing. Nonconsumptive uses like viewing wildlife are rarely studied and existence values have been almost completely ignored.[1/] A classic example of the latter issue is the case of the snail darter and the Tellico Project (Davis 1979). An important consideration was whether this relatively obscure fish, for which there was no current known use, was worth preserving. The existence value argument would imply that some people in the current generation may place a positive monetary value on the preservation of the snail darter even though they never plan on having any personal use for it. Still, questions remain about how such existence values fit into cost-benefit analyses and whether they can be quantified.

The objectives of the research reported in this paper were to develop a conceptual framework for examining the total value of a wildlife resource and to use this framework to estimate the values that Wisconsin residents place on the preservation of two of Wisconsin's endangered species of wildlife (bald eagles and striped shiners). Although the bald eagle is classified as an endangered species in Wisconsin, its status has been upgraded to a threatened species at the federal level. The striped shiner is a minnow whose primary habitat is in sections of the Milwaukee River and it is not classified as a federally threatened or endangered species. While neither of these species would be affected by an impending development project, they do provide an excellent opportunity to examine the types of wildlife values that are relevant to cost-benefit calculations for water resources projects. These two species of wildlife are of interest here because bald eagles represent a well known species for which there is no consumptive use and striped shiners represent a relatively obscure species. That is, much of the empirical work on the valuation of wildlife resources has focused on uses such as hunting and

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1/ Recent studies by Brookshire, Eubanks and Randall, Stoll and Johnson, and Walsh, Loomis and Gillman are exceptions to this statement.

fishing for fairly well known species. This type of narrow valuation framework would overlook the monetary values that members of society might place on the preservation of endangered species. In addition, most endangered species of wildlife are relatively obscure like the striped shiner and snail darter. Thus, values of particular interest are those which are not derived from direct contact with the wildlife species in question.

As was alluded in the preceding paragraph, bald eagles cannot be hunted and striped shiners cannot be fished in Wisconsin due to their status as endangered species. Yet, it would appear that some people derive satisfaction from seeing bald eagles soaring overhead and diving for fish. The striped shiner, in contrast, does not support any current or anticipated uses in Wisconsin. People may still feel that it is important to preserve this fish for various reasons such as a belief that genetic diversity is important, a feeling of responsibility toward the environment, or a desire to make a bequest to future generations. These types of motives give rise to economic values that are commonly referred to as existence values. Residents of Wisconsin may also be concerned with the preservation of bald eagles in the State, regardless of whether they will ever see one in the wild. These various types of concerns about wildlife motivate the values that were estimated as part of the research reported in this paper.

This paper is organized in the following manner. A conceptual framework for examining the total value of a wildlife resource is briefly discussed in the following section and will be followed by a short overview of existence value literature in the third section of this paper.[2/] A simple model of total value, with the valuation of bald eagles as a case example, is presented

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2/ : For an extensive discussion of the conceptual framework and the existence value literature, see Boyle and Bishop (1985).

in the fourth section. Actual value estimates are presented in the following section and the final section contains a discussion of how the estimated values can be incorporated in cost-benefit calculations and subsequently used in policy applications.

II. COMPONENTS OF TOTAL VALUE

Early cost-benefit analyses focused merely on the user benefits associated with environmental assets. Later theoretical analyses incorporated the concept of option value. First introduced by Weisbrod, the option value concept was subsequently refined and clarified (Bishop 1982; Freeman 1984 and 1985; Hanemann 1985; and Smith 1983 and 1984). Option value is an adjustment to the monetary measure of welfare to reflect the uncertainty consumers face when future states of the world are unknown. Recent developments indicate that option value may be either positive or negative. Thus, the traditional notion of the maximum that an individual would be willing to pay now to insure that an environmental asset will be available in the future is the sum of option value and the expected value of consumer surplus. This sum is option price.

While early cost-benefit analyses focused on use benefits, only a subset of such benefits were actually considered for empirical valuation. This was especially true in regard to the valuation of wildlife resources (Brown and Nawas; Gum and Martin; and Davis 1964). Only consumptive use values such as hunting and fishing were typically estimated. There are also nonconsumptive use values associated with wildlife. For example, people visit National Parks and wildlife sanctuaries with the intent of viewing wildlife. Bird watching is also an activity that some people enjoy. Some people in the Northwest may go out to watch the salmon runs, even if they never plan to fish for salmon.

There is also a hazy area of use that is not associated with direct contact with wildlife. Many people never come in contact with wildlife in its natural habitat, but they do derive satisfaction from it. Among other activities, they enjoy reading about wildlife, viewing pictures of wildlife, watching television specials about wildlife, and visiting zoos. Another form of indirect consumption arises from some types of wildlife research, e.g., research on birds that signaled rapid accumulations of pesticides.

These other uses may need to be specifically considered as they may be measured in different units than consumptive use or may have different per unit prices, and they may also have different parameters in individuals choice functions. These other uses may also have complementary or substitute relations to consumptive use.

As an outgrowth of the option value discussion, Krutilla suggested that people may value an environmental asset even though they are sure that they will never personally use the resource in question. This is in direct contrast to use values. Krutilla proposed two types of values that could arise under conditions where an individual's use demand for a resource is certain to be zero. The first is bequest value and is motivated by a desire to provide some of a resource for future generations. The second category is existence value and arises from the knowledge that a resource merely exists. That is, many people might be willing to pay some positive amount to know that a resource exists, even though they are sure that they will never personally use it. It is also conceivable that users and potential users of environmental assets may possess existence or bequest values. If this is the case, the expected value of consumer surplus is not merely comprised of use values.

Notions of option price and option value can be developed with respect to each of the three use arguments (consumptive use, nonconsumptive use and indirect use). For example, uncertainty could arise with respect to the price corresponding to any one of the use arguments. Option price and option value concepts can also be developed with respect to the existence argument if for instance individuals are uncertain as to whether they have existence motivations for a resource or if the population level of the resource is uncertain. Thus, it is necessary to evaluate the source of the uncertainty. In turn, option value is not merely a concept related to the potential for consumptive use of a resource, but rather is the result of uncertainty wherever it occurs in the consumers choice problem.

III. EXISTENCE VALUE

Recent theoretical discussions have treated bequests and pure existence as motivations for nonuse values and have referred to the entire category of nonuse values as existence value (Bishop and Heberlein; Fisher and Raucher; McConnell; and Randall). A recent empirical study attempted to differentiate between bequest values and pure existence values (Walsh, Loomis and Gillman).

Individuals who place a value on an environmental asset and are sure that they will never use this resource must be motivated by altruistic feelings.[3/] Bequest values reflect altruism toward future generations. The desire to know

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3/ Randall and Stoll have identified three types of altruism that could motivate existence values: interpersonal altruism, intergenerational altruism and Q-altruism.

that a natural environment merely exists reflects altruism towards nature. Several authors have argued or assumed that the basis for existence value is altruism (Boyle and Bishop 1985; McConnell; Randall; and Randall and Stoll). In contrast, Smith (1985) has suggested that altruism may not be the only motivation for existence values and includes indirect use as an additional motivation.

We would like to argue that the term existence value should be restricted to nonuse values that arise solely from altruistic motives. Thus, existence is a pure public good. Values that arise from indirect contact with a resource will be referred to as indirect use values. We advocate these definitions due to their intuitive and practical appeal. The names provide some insight into the characteristics of the categories. More importantly, there is a theoretical distinction that helps to clarify this definition of existence value. This is the notion of weak complementarity (Freeman 1979; and Mäler). Weak complementarity implies that people who do not demand a market good that is dependent on the environmental asset being valued will not be willing to pay any positive amount for the environment asset. There is no market good that is related to altruistic motivations so that methods of valuation that are based on weak complementarity cannot be used to measure existence values. As an alternative, the only tool available for estimating existence values is the contingent valuation method. Weak complementarity does apply to each of the use categories which implies that at a conceptual level these other components of value could be measured with one of the various indirect methods of valuation.

All of the preceding discussion has contained the implicit assumption that the marginal existence value of a resource is positive, as have other authors (see McConnell). It is possible that for some people the marginal existence value of certain resources may be negative. Consider the case of parents who have children who enjoy back-country hiking in Glacier National Park. The parents may be willing to pay some positive amount to know that grizzly bears do not exist in the hiking area and pose a threat to their children.

IV. A SIMPLE MODEL OF TOTAL VALUE

The model developed in this section specifically incorporates nonconsumptive use, indirect use and existence as arguments in an individual's utility function. This model is somewhat similar to a model developed by Smith (1985). Our model is different from Smith's in that we acknowledge more than one category of use, give a more precise definition of our existence argument and discuss an oversight in Smith's development of existence value. Using the valuation of bald eagles as an example, the choice problem is

$$\max_{e_i, z} U(e_1, e_2, Z, \gamma) \tag{1}$$

$$\text{s.t.} \quad P_e e + P_z Z \leq Y \tag{2}$$

$$e_i \leq g_i(\gamma) \ \forall \ i \tag{3}$$

$$\gamma = \bar{\gamma} \tag{4}$$

where e_1 is nonconsumptive use (viewing, photographing, etc.), e_2 is indirect (reading about, watching TV specials on, etc.), Z is a vector of market goods and services, γ is the bald eagle population level (existence argument) and $\bar{\gamma}$ is the current population of bald eagles.[4/] There is not a consumptive use argument due to the bald eagles designation as an endangered species. The symbols P_e and e are price and quantity vectors that reflect the two categories of use and P_z is a vector of market prices. The constraint on the use arguments $[g_i(\cdot)]$ could take the form

$$e_i \leqq g_i(\gamma) = [I_i(\gamma)]\ C \qquad (5)$$

and

$$I_i(\gamma) = \begin{cases} 1 \text{ if } \gamma \geqq \alpha_i \\ 0 \text{ otherwise} \end{cases} \qquad (6)$$

where $I_i(\cdot)$ is an indicator function, C is an arbitrarily large constant and α_i is a constant that varies across use arguments. If the population (γ) falls below α_i, there are insufficient eagles to support the ith category of use.

We will assume that the marginal utility of existence (γ) is positive and is increasing at a decreasing rate. Existence is treated as a pure public good. A specific individual may have any one, or combination of, these uses or may have existence motivations. All three are included for expository

4/ The important consideration is that people do derive satisfaction from bald eagles regardless of the units of measure. Thus, we are not overly concerned with the units in which the use arguments are measured in the present discussion. A similar approach was used by Schulze, Brookshire and Thayer to model existence motivations for visibility in National Parks. See Boyle and Bishop (1985) for a discussion of why the existence argument is modeled in this manner.

purposes. Consumptive use is not included as an argument since bald eagles are a nongame species.

The compensating variation definition of the total value (BETV) of bald eagles in this model is

$$V(P_e, P_z, \bar{\gamma}, Y\text{-BETV}) = V(P_e^m, P_z, 0, Y) \qquad (7)$$

where V(•) is an indirect utility function and the price vector (P_e^m) is a vector of lowest possible prices that are high enough that both use categories are zero.[5/]

The total use value (BETUV) of bald eagles is defined as follows:

$$V(P_e, P_z, \bar{\gamma}, Y\text{-BETUV}) = V(P_e^m, P_z, \bar{\gamma}, Y). \qquad (8)$$

Likewise, the component use values can be defined for the present model:

$$V(P_e, P_z, \bar{\gamma}, Y\text{-BENUV}) = V(P_{e_1}^m, P_{e_2}, P_z, \bar{\gamma}, Y) \qquad (9)$$

$$V(P_e, P_z, \bar{\gamma}, Y\text{-BEIUV}) = V(P_{e_1}, P_{e_2}^m, P_z, \bar{\gamma}, Y) \qquad (10)$$

Nonconsumptive use value is BENUV and indirect use value is BEIUV; both are compensating measures of value. There is no a priori reason to believe that the sum of the component use values is equal to total use value.

5/ It is important to realize that the following condition generally holds:

$$P_e^m \neq [P_{e_1}^m, P_{e_2}^m].$$

Total existence value is not easily defined when a person is both a user of a resource and also has existence motivations. This problem can be portrayed in the context of the current example. That is, when constraint (3) is binding the following condition holds:

$$\frac{dU}{d\gamma} = \sum_{i=1}^{2} \frac{\partial U}{\partial e_i} \frac{\partial e_i}{\partial \gamma} + \frac{\partial U}{\partial \gamma} . \qquad (11)$$

As a result it is extremely difficult to determine pure existence value in this case. It appears that this result holds regardless of the manner in which existence motivations are modeled as it is impossible to use a resource when it does not exist, an issue that Smith (1985) overlooked in his definition of existence value.

This is not a severe limitation if the researcher only desires to measure marginal changes in existence values or total value as may be the case for applied policy research. An alternative is to measure a conditional existence value. This value is

$$V(P_e^m, P_z, \bar{\gamma}, Y\text{-}BEEV_{e=0}) = V(P_e^m, P_z, 0, Y) \qquad (12)$$

where prices are such that all categories of use are zero. In Smith's (1985) model, existence value turns out to be merely total value minus total use value. This simple adding-up result does not hold for the current model due to the constraint specified in equation (3).

It is important to understand that the valuation question is even more complicated than presented here. Each of the three components of value have various features. Nonconsumptive use may involve going out with the intent of viewing bald eagles or incidentally seeing a bald eagle while you are driving or hiking. We have already discussed the various types of indirect use and various types of altruism. These three crude groupings of value components are used to represent the complexity of the valuation question. In addition, unless there is empirical justification to conclude that all consumers do not have altruistic motives, only valuing consumptive uses of a wildlife resource will in general result in an underestimate of total value.

V. PRELIMINARY RESULTS FROM AN APPLICATION

In a recent study we used the contingent valuation method to estimate the value of preserving two species of wildlife that are endangered in Wisconsin, bald eagles and striped shiners. The objective of this study was to test whether there are significant values that are not derived from direct contact with these wildlife resources. To facilitate this test, three types of values were estimated: a total value for bald eagles (BETV), a conditional total value for bald eagles ($BETV_{e_1=0}$), and a total value for striped shiners (SSEV). Striped shiner total value is existence value as there is not any current or anticipated use associated with these fish in Wisconsin.

The values to be estimated are defined in a manner similar to the definitions developed in section IV. The definitions are

$$V(P_e, P_z, \bar{\gamma}, \bar{\rho}, Y\text{-}BETV) = V(P_e^m, P_z, 0, \bar{\rho}, Y) \qquad (13)$$

$$V(P_{e_1}^m, P_{e_2}, P_z, \bar{\gamma}, \bar{\rho}, Y\text{-}BETV_{e_1=0}) = V(P_e^m, P_z, 0, \bar{\rho}, Y) \qquad (14)$$

$$V(P_e, P_z, \bar{\gamma}, \bar{\rho}, Y\text{-}SSEV) = V(P_e, P_z, \bar{\gamma}, 0, Y) \quad (15)$$

where $\bar{\rho}$ is the current population of striped shiners and all other arguments are as previously defined.

A. SURVEY PROCEDURES

The contingent valuation questions for the present study were included in a mail survey conducted by the Wisconsin Department of Natural Resources (DNR). The purpose of the DNR's survey was to determine why Wisconsin residents do or do not contribute to the State's Endangered Resources Donation (ERD) program. Questionnaires were mailed to samples of individuals from two subpopulations of Wisconsin taxpayers: (1) contributors to the ERD program in 1984, and (2) noncontributors to the ERD program in 1984.

One half of the individuals in each sample were asked a bald eagle total value question (BETV) and the other half were asked a conditional bald eagle total value question ($BETV_{e_1=0}$). All respondents were administered the striped shiner total value question.[6/] The payment vehicle for eliciting these valuation responses was a membership to a private foundation that would conduct the necessary activities to preserve the species in question. This is similar to the payment vehicle used by Stoll and Johnson in their study of whooping cranes at the Aransas National Wildlife Refuge in Texas.

6/ Given the finding of Randall, Hoehn and Tolley that contingent values for an item may vary depending on the placement of the respective valuation question in the valuation process, it would have been desirable to alternate the order of the valuation questions in the questionnaires. This was not possible due to certain research limitations. In turn, the striped shiner valuation question was preceded by a bald eagle valuation question in all questionnaires.

The dichotomous choice technique of contingent valuation, which has been used in several contingent valuation studies (Bishop, Heberlein and Kealy; Boyle and Bishop 1984; and Sellar, Chavas and Stoll), was used to elicit values. Respondents were asked to accept or reject fixed membership fees to the foundation to preserve the species in question. Offers were even dollar amounts that were randomly selected within fixed intervals on the range $1 to $100. The following excerpt is an example of the dichotomous choice valuation question that was used to elicit bald eagle total values from contributors and noncontributors.

> We would like you to pretend that all funding to preserve bald eagles in Wisconsin is terminated. Assume that without funding, there will not be an organized effort to preserve bald eagles in Wisconsin and bald eagles will become extinct in our state. Suppose that an independent private foundation is formed to preserve bald eagles in Wisconsin and to prevent the possibility of extinction. The activities of the foundation will include maintaining and restoring bald eagle habitats. Please assume that the foundation will be able to save the bald eagle.
>
> Pretend that the foundation is to be funded by selling supporting memberships. All members will be provided with information, at no cost, on how to conveniently view bald eagles in Wisconsin. Members who do not wish to view eagles will have the satisfaction of knowing that they helped preserve the bald eagle in Wisconsin. These people may have various reasons for wanting to preserve bald eagles. Some of these reasons might be: a gift to future generations, a sense of responsibility for the environment, sympathy for animals, and generosity towards friends and relatives.
>
> If a supporting membership cost $ per year, would you become a member and help to make sure that bald eagles will not become extinct in Wisconsin?
>
> ___ yes -- I would become a supporting member at this amount.
>
> ___ no -- I would not become a supporting member at this amount.

The blank in the valuation question is where the randomly selected membership fee was entered. A similar type of question format was used to elicit the conditional bald eagle total values ($BETV_{e_1=0}$) and the striped shiner values (SSEV).

B. SURVEY RESULTS

A total of 1,000 questionnaires were mailed to individuals in the samples. Five hundred questionnaires were mailed to contributors to the ERD program and an additional 500 were mailed to noncontributors. The overall response rate was 81 percent. The within group response rates were 89 percent for contributors and 73 percent for noncontributors.

C. VALUE ESTIMATES

A dichotomous choice estimate of value is derived by computing the area under an estimated logit function. Conceptually, this procedure is the equivalent of taking a weighted average. The general form of the logit model for the present study is

$$(1-\pi) = (1 + \exp(-\beta X))^{-1} \qquad (16)$$

where $(1-\pi)$ is the probability of a yes response to the membership fee question, β is a vector of parameters and X is a vector of explanatory variables that includes the membership fee. It should be noted that π is a cummulative distribution function.

Hanemann (1984) has shown that the functional specification of the βX term in equation (16) can be derived from utility theory. In this context, each of the three values defined in equations (13) through (15) would lead to a slightly different specification of the βX term. Following Hanemann (1984), the βX term associated with each of these three values can be derived by specifying a functional form for the indirect utility function, replacing the true value in each equation with a selected membership fee, and taking the difference between the left-hand side and right-hand side of each equation. This type of utility consistent specification was not possible for the present study because it was impossible to collect data on the implicit bald eagle price vectors (P_e and P_e^m) and the DNR chose not to ask respondents to report their incomes on the questionnaires.[7/]

The specification of the βX term for the estimated logit equations took the following form

$$\beta X = \beta_0 + \beta_1 \ln \text{(offer)} \qquad (17)$$

where the β_i are parameters and the offer is the membership fee. Empirical applications have shown that specifications like equation (17) provide the best statistical fit to the data and that income may not be a significant explanatory variable (Bishop, Heberlein and Kealy; and Boyle and Bishop 1984). This conclusion seems to be supported in the present study in that the specification of the βX term in equation (17) fit the data better than a linear in the variables specification that is consistent with a conventional

7/ We are currently trying to obtain secondary data on income since the sample for the study was drawn from Wisconsin Department of Revenue taxpayer records.

utility framework.[8/] In addition, the estimated linear specification resulted in a logit equation that violated the properties of a cummulative distribution function.

The estimated logit equations are presented in Table 1. All of the equations in Table 1, except equation (f), provided acceptable statistical results. The problem with equation (f) may be due, at least in part, to the small sample size for this subgroup of respondents. The β_0 coefficients were not significant in equations (i) and (j). Thus, equations are reported which do not include a constant term. This type of specification, without a constant term in the exponent, implies that the median response is $1. The bald eagle equations in Table 1 are classified as to whether respondents were viewers or nonviewers of eagles. This split was made on the basis of whether respondents reported having ever made a trip where one of their intentions was to view bald eagles.

The dichotomous choice values, that are derived from the estimated logit functions, are presented in Table 2.[9/] These estimated means are annual values for Wisconsin taxpayers. The means show some obvious patterns when one

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8/ A specification of the indirect utility function that is linear in its arguments would result in the income argument cancelling out when the two utility levels are differenced to derive the βX term in equation (16).

9/ The means reported in Table 3 are computed by truncating the range of integration of the estimated logit models. This is a procedure that has been used in several contingent valuation studies to cope with the large tails that can occur with estimated logit models (Bishop, Heberlein and Kealy; Boyle and Bishop 1984; and Sellar, Chavas and Stoll). A simple rule of thumb, discussed by Boyle and Bishop (1984), was used to choose the point of truncation. This is, the range of integration was truncated at the ninetieth percentile or the highest offer in the sample ($100 here), whichever was larger. The truncated models were normalized so that the areas under the p.d.f.'s equaled one.

TABLE 1. ESTIMATED LOGIT EQUATIONS

Equation			β_0	β_1	χ^2 Statistic	N
Contributors						
(a)	BETV	- Viewer	2.054*[a/] (0.795)[b/]	-0.641* (0.233)	9.118+[c/]	99
(b)		- Nonviewer	2.988* (0.810)	-1.149* (0.256)	28.821+	123
(c)	$BETV_{e_1=0}$	- Viewer	4.060* (1.260)	-1.297* (0.359)	21.939+	86
(d)		- Nonviewer	2.532* (0.741)	-0.885* (0.216)	21.146+	130
(e)	SSEV		--	-0.613* (0.049)	245.360+	435
Noncontributors						
(f)	BETV	- Viewer	1.257 (1.082)	-0.511 (0.338)	2.503	35
(g)		- Nonviewer	2.153* (0.700)	-1.150* (0.234)	33.351+	147
(h)	$BETV_{e_1=0}$	- Viewer	6.699* (2.599)	-2.161* (0.755)	16.994+	43
(i)		- Nonviewer	1.500** (0.785)	-0.942* (0.254)	15.210+	133
(j)	SSEV		--	-0.833* (0.073)	274.540+	355

a/ Single asterisk denotes significance at the 1% level and double asterisk denotes significance at the 10% level.

b/ Numbers in parentheses are asymptotic standard errors.

c/ Single plus sign denotes significance at the 1% level and double plus sign denotes significance at the 10% level.

looks across the rows and down the columns. A mean and median are not reported for the BETV for noncontributor-viewers because of the insignificant coefficients in equation (f) in Table 1.

TABLE 2. DICHOTOMOUS CHOICE VALUE ESTIMATES

Type of Value		Contributors		Noncontributors	
		Mean	Median	Mean	Median
BETV	- Viewer	75.31[a/]	24.63[b/]	--	--
	- Nonviewer	18.02	13.47	11.84	6.50
$BETV_{e_1=o}$	- Viewer	28.38	22.88	25.97	22.20
	- Nonviewer	30.78	17.46	10.62	4.92
SSEV		5.66	1.00	4.16	1.00

a/ Significance of the estimates is examined by testing the overall significance of the estimated logit equations. See the χ^2 statistics reported in TABLE 1 for these results.

b/ It is stated in footnote (9) that the dichotomous choice means were derived by truncating the range of integration and normalizing the logit models so that the areas under the p.d.f.'s would be one. The reported medians are for the untruncated models. The medians from the untruncated models are presented because a median is not as sensitive to the mass in the tail of a distribution as is a mean.

We hopothesized the BETV would equal $BETV_{e_1=0}$ for nonviewers. This null hypothesis could not be rejected at a 90 percent level of confidence for either contributors or noncontributors. The intuition behind this hypothesis is straightforward. Since the sample for this study was drawn randomly, nonviewers valuation responses should not have varied with the question format as the only difference in the two valuation questions dealt with the opportunity to view eagles in the wild. On the other hand, if there are significant values associated with viewing bald eagles, then BETV would be significantly larger than $BETV_{e_1=0}$ for viewers. The null hypothesis that these two values are equal could be rejected for contributors. This test was not performed for noncontributors because of the insignificant coefficients in equation (f) in Table 1.

As is often done in valuation studies, we expanded the estimated means to aggregate estimates of value for the population. Aggregate total values for bald eagles and striped shiners are reported in Table 3. At first glance these numbers may appear to be amazingly large, but once they are put into perspective, the magnitudes seem quite plausible. Considering that there are about 3 million taxpayers in Wisconsin, an average willingness to pay of just a few dollars per person will add up to a sizeable total. In addition, a substantial aggregate willingness to pay for bald eagles is reasonable due to the symbolism that is associated with these birds. In turn, these results are indicative that members of the current generation place a significant aggregate monetary value on the preservation of these two endangered species of wildlife.

TABLE 3. POPULATION VALUE ESTIMATES
($1,000)

Type of Value	Contributor	Noncontributor
BETV - Viewer	1,486.5	--
- Nonviewer	487.2	26,179.1
SSEV	264.7	11,762.2

VI. CONCLUDING COMMENT

Can contingent values, such as the estimates presented in this paper, be taken as clear evidence that intrinsic values for wildlife species are positive? Work at the University of Wisconsin and elsewhere is contributing to a growing confidence that contingent valuation produces use values that are sufficiently accurate to be useful in policy analysis (Bishop et al.; and Coursey et al.). However, doubts have been voiced as to whether this conclusion extends to more esoteric concepts like existence value (Cummings, Brookshire and Schulze). This is an issue that requires more research. In the meantime, it can be concluded that altruistic motives leading to positive utility from the existence of a wildlife resource is quite compatible with economic theory. Furthermore, the present contingent valuation results indicate a substantial willingness to pay that is not associated with direct contact with both a well-known and an obscure species.

A final question is, how can estimated wildlife values, such as the ones presented in this paper, be used in the public policy arena? Consider, as a classic example, a development project such as a dam. Benefits of the dam could be hydroelectric power generation, flood control, a reliable source of irrigation water and/or recreational boating opportunities. Assume, for the sake of argument, that the dam will destroy a critical portion of the habitat of an endangered species of fish. Construction of the dam may not result in the extinction of these fish, but it could contribute to the eventual extinction by causing a reduction in the population. To complete this scenario, assume that there is no current use for this fish, but that its preservation may be important for genetic diversity and it may provide some type of use benefits to members of future generations.

The existence value concept, as discussed in section III, would imply that members of the current generation might be willing to pay some positive amount to prevent a reduction in the population of these fish. Assuming that existence values could be estimated with valid contingent valuation techniques, the estimated values would be counted as a cost in the cost-benefit ledger for the dam. Yet, this type of cost-benefit calculation is not as straightforward as it may appear at first glance because there are various sources of uncertainty which enter the analysis. For example, the benefits to future generations from the preservation of this fish might be unknown and the probability distribution for the occurrence of these benefits is likely to be unknown. Another source of uncertainty might be the effect that the dam will have on the survival of this species of fish. Of course, there are numerous other sources of uncertainty, but these examples suffice to establish the complexity of the preservation issue. In addition, extinction is an irreversible act; whereas postponing the construction of the dam does not mean that the dam could not be built in the future.

One way to analyze this type of development/preservation issue under conditions of uncertainty is with a safe minimum standard (SMS) framework and using a game theoretic approach (Bishop 1978).[10/] Within this type of

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10/ The type of analysis outlined in this section is not limited to obscure species of wildlife for which there is no known use. Examples of endangered species that may generate both current use values (e.g., viewing) and existence values are the bald eagle, as discussed in this paper, or the California condor and the California tule elk (Bishop 1980). For these types of species, the appropriate estimate of current period values would include both use values and existence values.

analytic framework, a cost of development, or a benefit of preservation, in the current period would be the total value that members of the current generation place on maintaining the existing population of the species. Since the benefits of preservation accruing to future generations are unknown, the decision rule, as stated by Bishop (1980), is to "...avoid extinction unless the social costs of doing so are unacceptably large" (p. 210). A second approach, which is somewhat similar to Bishop's in content and may be slightly more tractable on a conceptual level, is the concept of quasi-option value which was introduced by Arrow and Fisher, and has been clarified by Conrad, by Fisher and Hanemann and by Hanemann (1985). The quasi-option value approach allows for the possibility of learning about the benefits of preservation if construction of the dam were postponed. The concept of quasi-option value is technically based on an assumption of perfect information, but in reality, future benefits and costs, and their distributions, are unknown. The best that probably can be done in this type of analytic framework is to do a simulation analysis of potential scenarios. With a simulation analysis, there is an opportunity to perform a sensitivity analysis to examine how assumptions about the size of future benefits and costs, and probability distributions affect the outcome of the analysis. This type of analysis can be useful as a learning process, but we question its usefulness as an ultimate decision rule. Ultimately, Bishop's game theoretic approach may be more tractable at an empirical level. The critical issue for both of these approaches is that a portion of the opportunity cost of foregone fish habitat, the value that members of the present generation place on preservation, is counted in the cost-benefit calculations and policy makers are not left with little or no information about the benefits of preservation and the ramifications of various management strategies. The bottom line is that if all of the discounted benefits of development exceed all of the discounted costs that are quantifiable, this is not an unqualified statement to proceed with a project as is implied by the SMS decision rule.

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