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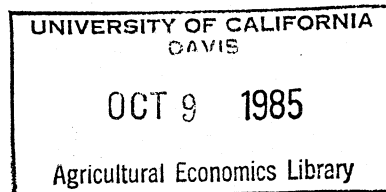
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INFORMATION DISCLOSURE AND ENDANGERED SPECIES VALUATION ¹

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Karl C. Samples
Department of Agricultural and Resource Economics
University of Hawaii

John A. Dixon
Environment and Policy Institute
East-West Center

Marcia M. Gowen
Resource System Institute
East-West Center



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ABSTRACT

A conceptual household production model is proposed which illuminates how information disclosed to respondents can influence reported willingness to pay (WTP) to preserve unique resources such as endangered animal species. The model indicates that information disclosure can influence reported WTP both by altering respondents' marginal rate of substitution of income for the resource being valued, and by changing the perceived efficiency of money investment in specific preservation activities. Results of a controlled experiment are described to empirically evaluate the link between reported WTP to preserve humpback whales and information disclosed about their physical and behavioral characteristics, and endangered status. Significant differences (at the 0.20 level) in mean reported WTP were observed between experimental and control groups exposed to differing levels of descriptive information concerning humpback whales. Additional empirical results show that information pertaining to physical characteristics and endangered status significantly influenced respondents' allocations of fixed budget amounts among animal preservation funds.

INFORMATION DISCLOSURE AND ENDANGERED SPECIES VALUATION

Introduction

It is proposed and tested here that an individual's reported willingness to pay (WTP) to preserve a particular animal is significantly influenced by information provided about the animal's physical and behavioral characteristics, and about its endangered status. While this proposition may appear obvious, it bears important implications for the proper type and amount of information disclosed in preservation valuation studies. The proposition also raises serious question about the replicability and usefulness of valuation results in a world of dynamic public awareness about endangered species and preservation alternatives.

Prior research has recognized the potential influence of information disclosure on value estimates obtained using the contingent valuation method (CVM). For example, early in the development of CVM, Randall, Ives and Eastman (1974) argued for the need to supply adequate information to respondents in order to create credible hypothetical market situations. Subsequent attention has largely focused on determining the strength and direction of bias associated with providing information to respondents about available substitutes, other respondents' expressed WTP, and expected WTP. Disagreement remains about whether these survey design aspects of information disclosure significantly bias estimates of true underlying values (Schulze, d'Arge and Brookshire, 1981; Rowe and Chestnut, 1983).

A more fundamental methodological question that has heretofore been largely ignored concerns the appropriate amount and type of information that an analyst should convey to respondents about the resource being valued.² Here the empirical issue lies less with obtaining biased estimates of true values, but more with the possibility that respondents' underlying true values may be altered or learned in response to information assimilated during the valuation interviews. This potential effect of information disclosure poses two difficulties for valuation practitioners. First is the unsettling problem that the analyst can influence valuation results simply by altering information provided to respondents. Secondly, replication of results may prove difficult if preferences are not stable from one interview to another due to differences in information disclosure across interviews, combined with learning and memory loss on the part of respondents.

This paper has two purposes relating to information disclosure and endangered species valuation. First, the link between information and reported WTP is explored conceptually within the context of a household production theoretical framework. Afterwards, results of several empirical tests for effects of information disclosure on WTP are presented. Throughout the paper the focus of the discussion is on endangered species valuation where the effects of information disclosure may be especially acute. This is because for many endangered species, respondents may not be familiar with the resource being valued because the non-use component of total value is proportionally

large. Limited contact or use in many instances breeds ignorance, especially when information about the species is costly for an individual to obtain. While admittedly endangered species valuation is frontier area for CVM application, it serves to illustrate the conceptual and empirical issues surrounding information disclosure and resource valuation in general.

Information and WTP for Species Preservation: The Theory

Household production theory offers a convenient way to better understand the factors that influence an individual's revealed WTP for preserving an endangered species. The theory also provides a point of departure for exploring the connection between information disclosure and reported preservation values. A rational individual's problem is to:

$$\text{Max } U(P, X)$$

subject to:

$$Y \geq C(P) + G(X)$$

$$P = g(A_1, A_2, \dots, A_n)$$

$$X = r(H_1, H_2, \dots, H_m)$$

$$A, X, P, H \geq 0$$

where P is, for simplicity, represents the preservation status of a single animal species, X is a vector of all other events or activities that enter the utility function, Y is income, $C(P)$ is the cost of achieving various levels of preservation as measured perhaps by population size, and $G(X)$ is the total cost of X . In

the household production framework, the individual "produces" P and X by combining sets of inputs (A, H) according to deterministic technical production relationships (g, r) . For example, inputs that go into the production of an animal's preservation might include monetary contributions to a preservation fund, donations of volunteer time, writing letters to legislators, and so forth. The individual's problem can be approached in two steps. The first step is to choose optimal input combinations of A and H to minimize the cost (W) of achieving a given level of P and X . That is:

$$\min W(P, X) = \sum w_i A_i + \sum z_j H_j$$

subject to $P = \bar{P}$ and $X = \bar{X}$, and subject to the production relationships g and r . Parameters w_i and z_j ($i = 1, \dots, n; j = 1, \dots, m$) are fixed input price vectors. The Lagrangian expression for constrained optimization can be written as:

$$\min L = \sum w_i A_i + \sum z_j H_j + \lambda_1 (P - g(A)) + \lambda_2 (X - r(H))$$

and necessary conditions for an interior solution are given by:

$$\partial L / \partial A_i = w_i - g'_i(A) = 0 \text{ for all } i$$

$$\partial L / \partial H_j = z_j - r'_j(H) = 0 \text{ for all } j$$

$$\partial L / \partial \lambda_1 = P - g(A) = 0$$

$$\partial L / \partial \lambda_2 = X - r(H) = 0.$$

The necessary conditions show that to optimally produce P , inputs should be selected such that $w_i = g'_i(A)$ for all i . If it happens that the perceived marginal productivity ($g'(A)$) for an input is

low, then little will be demanded unless w is correspondingly low. Alternatively stated, if the individual was bidding for preservation inputs in a Walrasian auction, the maximum rational bid for an input would be governed largely by the productivity of the input in the production of P . Note that this is true regardless of the marginal utility of preserving the animal species ($\partial U / \partial P$).

Once least cost combinations of H and A are given, then the individual proceeds with the more traditional utility maximization problem, subject to a budget constraint. At this juncture the marginal rate of substitution (MRS) between preserving an endangered species and income (or X) becomes a critical factor guiding choice. It is straightforward to show that changes in preservation budget allocations will occur until $\partial U / \partial P = \partial C(P) / \partial P$.

It is apparent from the model that information disclosure can potentially influence an individual's WTP for animal preservation through at least two avenues. This is because revealed preservation values have both demand and supply dimensions. On the demand side, an individual is willing to trade income for continued preservation of a species. A stated preservation bid therefore reflects the individual's MRS between income and provision of a public good (animal preservation).³ Willingness to trade income for preservation is tied to use and non-use values derived from an animal's existence (McConnell, 1983). The link between information assimilation and MRS for preservation can be

viewed in two ways, depending on how sovereign consumers are assumed to be. One view, shared for example by Scitovsky (1976), is that information about the characteristics of an animal, or about other animals, can stimulate a restructuring of preferences (specifically $\partial U/\partial P$) in the same way that advertising stimulates changes in spending behavior. Freeman (1984) and others view the situation somewhat differently, and suggest that information disclosure permits individuals to "discover" unfamiliar areas of their preference mappings. Introspection can therefore lead to changes in behavior even though underlying preferences remain intact. Regardless of whether preferences are changed or discovered by disclosure of new information, the outcome is essentially the same...a revised expressed willingness to pay for preservation. Such changes may be especially noticeable in valuing resources such as endangered species where small increments to knowledge can lead to dramatic shifts in values (Randall and Stoll, 1984).

A complicating factor is that in revealing WTP for preservation an individual is usually put in the position of being a supplier of funds somehow to be invested in preservation. A prudent investor weighs the relative efficiency ($g'(A)$) of alternative time and money expenditures towards achieving personal or social preservation objectives. Knowledge of investment performance will influence preservation budget allocations. Imagine, for example, the difficulty in collecting funds to preserve a ubiquitous and non-threatened species such as the English sparrow. It is quite likely aggregate revealed

preservation WTP will be low. This is not because sparrow preservation has little social value, but because the general population perceives the marginal efficiency of investment in sparrow preservation to be low. In view of the insignificant threat to the English sparrow's continued existence, a dollar contributed to its preservation will yield less marginal return to the cause of preserving animals or plants, than a dollar contributed to another preservation alternative. For similar reasons, donations to save the last surviving male of a nearly extinct animal species would expectedly be miniscule. Who would pay into a fund to save a species if it is thought to be beyond salvage? However, the situation could change appreciably if perceived investment efficiency increases, perhaps due to news about the discovery of a larger breeding stock. Reported WTP for preservation could increase even though preferences for preservation remain unchanged.

Although the household production model does not explicitly include information as an argument, the following hypotheses are suggested regarding potential impacts of information disclosure on reported WTP for animal preservation. First, stated preservation bids for a particular species will expectedly be low when the individual learns that population size is so large as to make preservation nearly assured regardless of preservation bid amount. Similarly, low bids are anticipated from an individual who knows that the population size is so small as to make extinction inevitable, regardless of the amount of the preservation donation. Furthermore, even when preservation

contributions are deemed to be an efficient method to produce preservation, bids would also be low if the individual learns that the endangered creature is in some way unattractive, or the importance of its preservation relative to the consumption of other goods and services is less than previously conceived. Finally, in the absence of information differentiating a number of species, preservation bids for each species would expectedly be uniform.

Experimental Design and Valuation Methods

Effects of information disclosure on reported WTP for animal preservation were empirically evaluated using two different approaches. The first approach was conducted in an experimental setting. Bids to preserve humpback whales (megaptera novaeangliae) were observed for two groups of individuals exposed to differing amounts of information about the humpback whale's physical and behavioral characteristics, and its endangered status. One-way analysis of variance was used to statistically compare mean reported bids for the two groups. A second, and markedly different approach entailed asking respondents to allocate a lump-sum cash windfall among preservation funds for three different animals. Information provided to respondents about the animals was varied in four separate iterations of the allocation problem. Analysis of variance was used to statistically compare mean allocation amounts under alternative levels of information disclosure.

Humpback Whale Preservation Fund Experiment

The experiment consisted of three parts and was conducted using isolated experimental and control groups of paid student subjects. During Part I, all subjects completed identical questionnaires that collected information on their socioeconomic status, animal preservation attitudes and knowledge about whales. Subjects were also questioned about their annual willingness to pay to preserve humpback whales.⁴ CVM was used to measure humpback whale preservation bids for two reasons despite possible biases identified with the method by Rowe and Chestnut (1983), and others. First, the CVM portion of the experiment focused on measuring relative mean preservation bids within and between experimental and control groups rather than estimating absolute mean bids for a defined population. Presumably biases in CVM would work with equal strength within and across groups and thereby leave relative mean bids undistorted. Secondly, use of the method permitted a relatively large number ($n=240$) of observations for humpback whale preservation bids to be obtained efficiently and at relatively low cost.

Part II involved subjects viewing one of two 25-minute color films. The experimental group viewed "The Singing Whale", a Jacques Cousteau film describing songs and behavior of the humpback whales and the threats to their survival. Concurrently, the control group viewed a film unrelated to whales, "The Sixty Second Spot: The Making of a Television Commercial."

Part III of the experiment immediately followed the film presentations and involved all subjects completing identical questionnaires. This questionnaire repeated questions from Part I concerning humpback whale knowledge. Through question repetition, the experimental groups' assimilation of information relating to humpback whales could be measured. Subjects were also asked to reconsider their whale preservation bid revealed in Part I and to state a final preservation bid.⁵ It was hypothesized that the the mean preservation bid for the experimental group would be different from the control group after both groups had viewed the films. It was further speculated that the mean preservation bids for the experimental group would be different before and after the film.

Preservation Fund Allocations

As a final survey procedure, a series of questions were posed to all control and experimental subjects in which each was asked to fully allocate a lump-sum windfall gain of \$30 among preservation funds for three animal species. Subjects were confronted with four allocation scenarios, each containing different levels of information. In Case 1, no definitive information about the animals was provided and species were simply identified as X, Y and Z. Case 2 provided additional information about the physical appearance of each species. In Case 3, information was given to subjects about the endangered status of the animals but not about physical appearance, and Case 4 included information on both physical appearance and endangered

status. By asking subjects to allocate a fixed sum based on different levels of knowledge, comparisons could be made between mean allocations and the type and amount of information provided on the animals. At the same time, it avoided some of the strategic biases associated with CVM because the allocation games involved costless choices.

Results

Before making comparisons between responses of experimental and control group members, the hypothesis was tested that the two groups were drawn from the same population. Statistical comparisons were made between the control and experimental groups based on responses obtained in Part I. On the basis of comparisons of income, age, previous donations (time or money) to animal preservation causes, and attitudes about preservation, the hypothesis that the groups were the same could not be rejected at the 0.05 level. Furthermore, mean performance of both groups on a 8-question multiple choice test about humpback whales was nearly identical in Part I. However, using contingency table tests, it was apparent that the experimental group had a history of more visual contact with whales compared with the control group.

After the films were shown, the percentage of correct answers on the multiple choice test administered in Part III increased from 16% to 72% for the experimental group. The control group's percentage of correct answers remained virtually unchanged at 17% both before and after viewing their film.

Humpback Whale Preservation Fund Results

In view of the fact that the experimental group apparently assimilated information on humpback whales, it was hypothesized that WTP bids for the experimental group would be different before and after the film. Mean bid results for both groups before and after the film are summarized in Table 1. Before calculating mean bids, however, observations were excluded from further analysis where subjects had not responded to either (or both) of the WTP questions in Part I or Part III. This eliminated 13 observations and left 115 in the experimental group and 113 in the control group. The mean bid for the experimental group was higher (18%) than the control group before the films were shown. Although the difference was not significant at the 0.40 level, it is consistent with the fact that the experimental group had significantly more previous whale sightings. This was interpreted as an indication of a relationship between use value and expressed WTP.

After the films were shown and respondents were asked to reevaluate their earlier humpback whale preservation bids, 32% of the experimental group and 20% of the control group increased their bids from their original values. In both groups, 3% of the subjects reduced their bids. As a result of these adjustments, the mean preservation bid for the experimental group and control group increased by 33% and 20%, respectively. Increase in mean bids for the control group was not expected but a difference was detected at the 0.50 significance level. This finding points to

TABLE 1

WILLINGNESS TO PAY (WTP) FOR HUMPBACK WHALE PRESERVATION:
 STATISTICAL COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Information State	Mean Observed WTP (\$ per year) ^a		Calculated t-Statistic ^b
	Experimental Group N=115	Control Group N=113	
Before Films	42.84 (6.84)	36.33 (4.67)	0.78
After Films	57.06 (8.27)	43.71 (6.48)	1.27

^aStandard errors of means in parentheses.

^bT-Statistic for difference between means for experimental and control groups.

the subtle ways in which respondents' attitudes are dynamic, perhaps in this case due to introspection and self-evaluation. Furthermore, it lends support to the view that preferences are learned during the interview process, even in the absence of new relevant information. The absolute change in mean bids (before and after the film) was more pronounced for the experimental group, and the difference was significantly different from zero at the 0.20 level. Similarly, the difference between mean bids observed for the control and experimental group after the film was significantly different from zero at the 0.20 level.

Differences between mean bids were further explored by eliminating observations where zero bids were reported in either (or both) of the WTP questions in Part I or Part III of the experiment. This was done to account for the fact that zero bids may reflect protest bids rather than actual willingness to pay. Due to the nature of the experiment, zero bids could not be probed to determine whether they were protest or legitimate zero bids. As a consequence of ignoring zero bids, 14 additional observations were dropped from the experimental group and 24 observations were dropped from the control group. Understandably, elimination of zero bids increased mean bids for both groups. Relative differences in bids, however, remained fairly constant for both groups. Again, the hypothesis that the mean bids were the same for the experimental group before and after the film could be rejected only at the 0.20 significance level.

Allocation to Preservation Fund Results

The effect on information disclosure on preservation valuation was more evident in the results of the preservation fund allocation problems. Mean allocation results for varying levels of information provided to subjects are summarized in Table 2. The table is organized from top to bottom according to increased information disclosure. Clear patterns about the impact of information on mean allocations are evident both across species and across questions. In Case 1 (no information), mean allocations were not significantly different as evidenced by the low calculated F-statistic for the hypothesis of equality between the three mean estimates. Faced with zero information distinguishing species, it appears that subjects were willing to pay to preserve each species nearly equally. In Case 2 (information on physical appearance), mean allocations were significantly different from one another and from those in Case 1 at the 0.05 level. Reflecting a strong anthropomorphic tendency, subjects gave larger allocations to the monkey-like animal as compared with the rabbit-like or rat-like animal.

In Case 3 (information on endangered status), respondents' mean allocations differed significantly across species, and changed significantly from mean values obtained in Case 1 at the 0.05 significance level. Furthermore, compared with Case 1 where mean allocations were essentially the same, subjects allocated significantly more funds to the animal that was endangered but savable as compared with either the ubiquitous or extremely rare

TABLE 2
PRESERVATION BUDGET ALLOCATIONS WITH
VARYING LEVELS OF INFORMATION DISCLOSURE

Case	Information Disclosed	Mean Preservation Allocation ^a N=240			F-Statistic
		Species A	Species B	Species C	
1	None-Species Unknown	\$ 9.96 (0.11)	\$10.14 (0.15)	\$ 9.93 (0.11)	0.9
2	Physical Appearance	Rabbit 10.21 (0.18)	Monkey 12.58 (0.25)	Rat 7.17 (0.22)	150.4 ^b
3	Endangered Status	Not Endangered 2.68 (0.30)	No Salvation 4.05 (0.39)	Endangered but Savable 23.39 (0.48)	846.1 ^b
4	Physical Appearance and Endangered Status	Rabbit & Not Endangered 3.37 (0.34)	Monkey & No Salvation 4.86 (0.44)	Rat & Endangered but Savable 21.60 (0.55)	505.4 ^b

^aStandard errors of means in parentheses.

^bSignificant at 0.01 level.

animals. In some respects it seems peculiar that respondents were on average willing to allocate nearly 10 percent of their budgeted funds to save Species A even though they were informed it was a lost cause. During survey pretests, respondents were queried about their motives for making such allocations with low expected payoffs. Motives ranged from a display of solidarity for the species in the face of its tremendous adversity, to an investment in the remote possibility that the animal's endangered status would somehow improve.

In Case 4 when information was disclosed on both physical appearance and endangered status, the endangered but saveable species received the highest allocation followed by the rare and abundant species. Mean allocation values were quite similar in Cases 3 and 4 for species with the same level of endangerment despite the added information about physical appearance in Case 4. These results suggest that information about endangered status may be relatively more important to respondents than information about physical characteristics in formulating preservation bids.

Conclusions

It has been proposed here that an individual's willingness to pay to preserve a particular animal is tied to the individual's marginal rate of substitution between income and preservation, and the perceived marginal efficiency of investment in a preservation fund. If so, information provided to the individual that changes either the marginal rate of substitution or the

marginal efficiency of investment will affect revealed preservation bids. Results of this experiment lead to rejection of the hypothesis that no relationship exists between respondents' WTP to preserve humpback whales, and information disclosed about its physical characteristics, behavior and endangered status. Furthermore, in the case of preservation budget allocation it is unambiguous that information disclosure can influence perceived marginal efficiency of investment in a preservation fund, and thereby result in changes in an individual's budget allocation strategy.

Taken together, the empirical findings point to the importance of information disclosure when applying CVM to estimate social values of species preservation. Of perhaps greatest concern is the fact that information, appropriately selected, can influence the outcome of valuation studies. This raises the obvious question of how much and what type of information should the analyst provide to respondents in interview settings. One alternative is to accept the state of respondents' ignorance about the resource as given, and provide only enough information about the resource to create a realistic market situation. Although this has the advantage that the analyst is not able to overtly manipulate responses, a disadvantage is that respondents may not readily accept operating in a hypothetical market situation with unknown payoffs and opportunity costs. At the other extreme, the analyst could provide vast amounts of information to respondents about the resource being valued, along with complete information about its substitutes and complements.

Aside from being operationally impractical, this alternative could change the preference mappings of respondents and therefore make individual values endogenous to the valuation process. While other mixed strategies obviously exist, it is beyond the scope of this paper to either suggest or defend any particular standard for information disclosure. Nevertheless, evidence presented here strongly suggests it is a matter worthy of further inquiry.

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Footnotes

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²Notable exceptions include work by Brookshire et al. (1979) and Randall and Stoll (1984).

³This abstracts from problems of strategic behavior and free ridership that may influence revealed preservation bids. Throughout this discussion it is assumed that revealed bids in fact reflect the individual's underlying preferences and household production relationships.

⁴Subjects were first informed about the objectives and operation of a humpback whale preservation fund. Afterwards, subjects were told: "We are interested in finding out how much money you would be willing to donate each year into the HUMPBACK WHALE PRESERVATION FUND. You would not be required to actually begin making cash payments until after you have finished your studies and have obtained a job. In the space below, write the MAXIMUM amount you are willing to donate each year to the HUMPBACK WHALE PRESERVATION FUND."

⁵Subjects were told "You have just seen a movie. Given your current knowledge, beliefs and feelings, we would like to ask you

to reconsider the amount of money you stated you would be willing to pay each year into the HUMPBACK WHALE PRESERVATION FUND." The rest of the question read exactly the same as the one quoted in footnote 4.