CUIMR-R-86-078 C2

PAPER PRESENTED AT THE FOLLOWING:

Workshop on Marine Pollution and
Environmental Damage Assessment

Co-sponsored by

Association of Environmental and Resource Economists

U.S. Environmental Protection Agency

and

National Oceanographic and Atmospheric Administration

Narragansett, Rhode Island
June 5-6, 1986

ECONOMIC VALUATION OF MARINE WILDLIFE:
DOES EXISTENCE VALUE EXIST?

by

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Abstract: Yes.

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Crucial to the implementation of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, 1980) is development of viable and appropriate methods for assessing natural resource damage in polluting incidents. Regarding marine ecosystems, damage assessment methodology must address the increased potential for the occurrence of damaging incidents affecting marine resources as coastal development proceeds. Only some marine resources are transacted in commercial markets so that only a portion of societal values lost are revealed through market values. Though it is generally recognized that additional societal losses associated with damage to non-marketed biological systems should be evaluated, ongoing discussions under the CERCLA have yet to determine how such values should be quantified.

As evidenced by strong public support for the Marine Mammals Protection Act (1972) and various incidents such as Alaskan residents' protest of the live capture of non-endangered killer whales in 1984, society places some value on preservation of marine wildlife. Clearly, optimal policy choices are hindered by the uncertainty associated with the likelihood of damaging incidents, the extent of their effect on marine wildlife, and society's value associated with such effects. The following discussion will address this last issue in a presentation of results of a contingent valuation study conducted to determine Californians' economic values for protected marine mammals. Analysis of results will incorporate a discussion of non-market valuation issues which must be addressed if wildlife valuation is to be meaningful in a policy context.

Previous authors have argued convincingly for consideration of total economic value of natural resources, of which market value is often just a subset (see, e.g., Randall and Stoll, 1983, Boyle and Bishop, 1985). In this regard, two methodologies--the travel cost method and the contingent valuation method (CVM)--have been used in recent years in a large number of environmental quality and recreational settings. In the context of public policy, benefits estimation of public natural resource programs has taken on greater importance in the current era of fiscal responsibility; thus, use of both methods has received greater attention and acceptability. For example, explicit measurement of recreational/aesthetic benefits is required by the Water Resources Council (unit day values), the U.S. Forest Service's Resource Planning Act (values for hunting and fishing), and the Bureau of Land Management's Rangeland Investment Policy Act. Under the Marine Mammals Protection Act (Section 2(6)), marine mammals are recognized as "resources of great international significance, aesthetic and recreational as well as economic, and it is the sense of Congress that they should be encouraged to develop to the greatest <u>extent feasible commensurate with sound policies of resource management</u>" (emphasis added).

However, very little research has been conducted to quantify the non-market benefits associated with wildlife. Of the few studies which exist, almost all have been directed at valuing consumptive uses; i.e., the recreational values for hunting and fishing. The travel cost method, especially, has been refined considerably through a large number of applications (see, e.g., McConnell and Strand (1981), Miller and Hay (1984), and Huppert and Thomson (1984). Though these studies have demonstrated the feasibility of deriving consumer surplus values associated with hunting and fishing, these measures do not include non-consumptive values which may

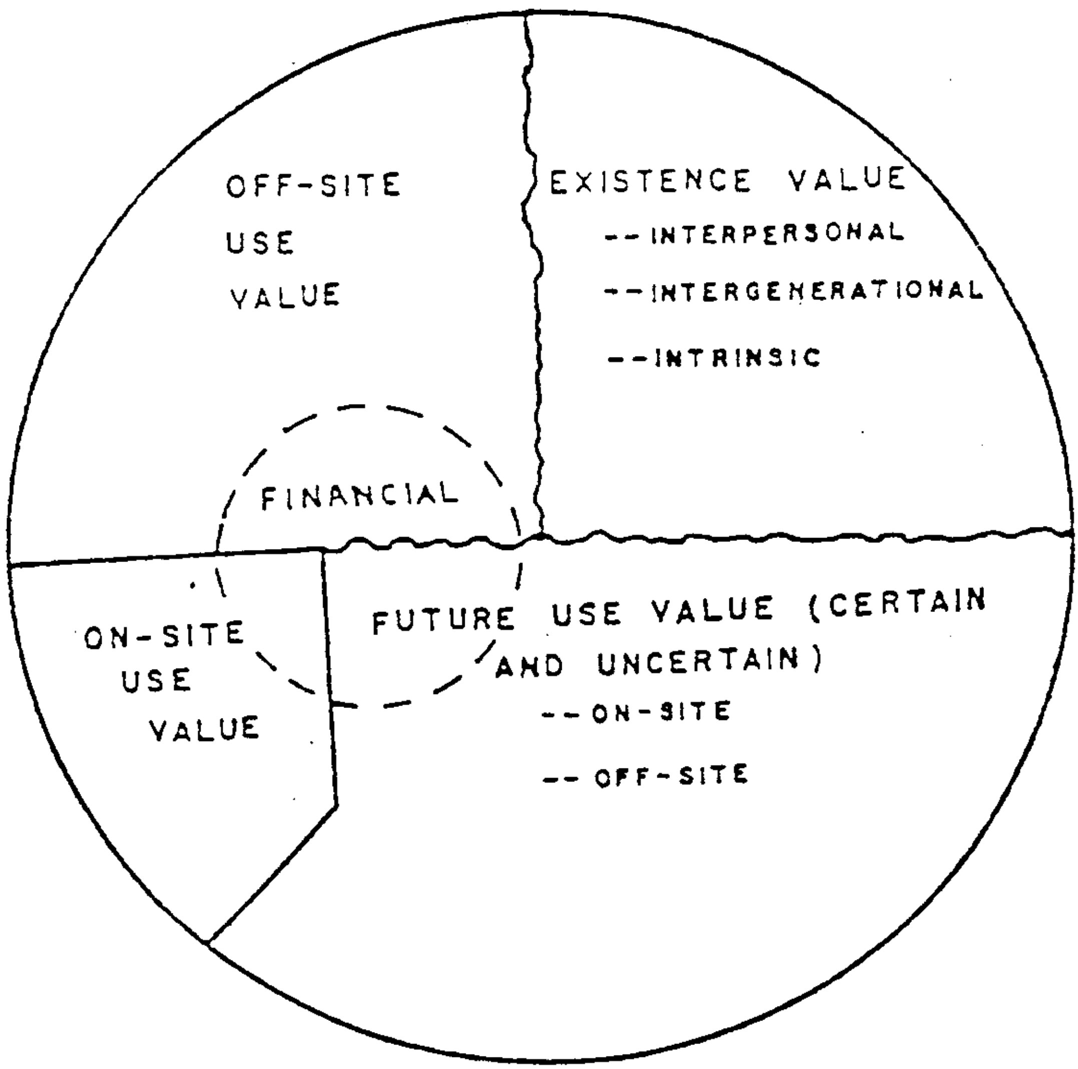

Figure 1. Total value framework.
(from Randall and Stoll, 1983)

exist. This may be a non-issue for many managed fish stocks and animal populations, but it may be a problem for estimating valuations for marine wildlife where hunting and fishing are either disallowed or not desired, and even sitings are not common.

The contingent valuation method has been applied in a very small number of studies in order to elicit estimates of individuals' values for animal species. The CVM study cited most frequently is perhaps that of Bishop and Heberlein (1979) in which the consumer surplus value for goose hunting in Wisconsin was investigated. Another CVM study conducted by mail was reported by Brookshire, Eubanks, and Randall (1983). This study asked hunters to reveal willingness to pay for future hunting permits for grizzly bear and bighorn sheep. Hunters were also asked for non-use values, i.e., willingness to pay to observe the animals, but Stoll and Johnson (1984) conducted the first willingness-to-pay survey of non-hunters for a protected wildlife population. This study elicited values for whooping cranes which can be observed at the Aransas Refuge in Texas. In two recent studies, Boyle and Bishop (1985) and Hageman (1985) investigated non-market valuations for wildlife populations which are neither hunted nor are they always observable in the wild. What follows is a discussion of results from the latter study.

Before proceeding, it is useful to outline the types of benefits for which marine mammals are valued. Mendelsohn (1984) has compiled a comprehensive list of relevant benefits which is presented here without elaboration. These are: consumptive and non-consumptive recreation, indirect recreation by way of media exposure (films, books), bequest value, "chemical mining," research on chemicals and genetics, experimental value, pest control, enhancement of other desired species (i.e., importance in the food chain), option and quasi-option values, and existence value. After a generally persuasuve discussion of each, Mendelsohn argues that use values only are relevant for measurement of the benefits of preserving endangered species. The utilitarian argument is that all other non-use values, such as option value or existence value, are in fact use values which are being double-counted in benefits elsewhere. For example, the argument is posited that existence value does <u>not</u> exist, and that if people were allowed <u>no</u> information on the animal stock (precluding not only visits, but also media information), then willingness-to-pay for blind faith in the animals' continued existence would be zero.

We take issue with the strictly utilitarian approach to value measurement for marine mammals and other animal populations. It <u>may</u> be true that existence value is zero when it is narrowly defined to preclude all direct and indirect exposure to the animals or information about the animals, but this is strictly conjecture. Even if we accept the conjecture, the question arises as to how, then, are total use values to be measured? Mendelsohn argues that these values are captured in payments for movies, television documentaries, live zoo and aquarium exhibits, books, and artwork. However, an effort to enumerate the large number of multi-media exposures for any particular animal and to thus estimate the total willingness-to-pay for that species would generally be such an enormous task as to render it an impossible endeavor. Furthermore, conversations with individuals frequently reveal that at least some people adamantly claim their values are <u>not</u> tied to utilitarian concerns. Even if we concede that such individuals actually value animal species because of what might be defined broadly as a utilitarian concern for ecological integrity which is necessary for the human species' long-term survival, we would argue that the issue is one of semantics.

For the purposes of the study described in the next sections, existence value is defined as the maximum willingness-to-pay for those benefits which are not tied to direct use (neither consumptive nor non-consumptive). By direct non-consumptive use, we are referring to current or future on-site observation of animal populations. The distinction is important because it allows individuals to indicate their values even though current or future uses are not intended. In this way, damage assessment for detrimental effects of marine pollution on wildlife need not be tied necessarily to losses in observation/recreation opportunities. In the section which follows, the CVM survey structure is described and results are provided which speak to potential biases discussed in the CVM literature. Also, valuation estimates of California households are reported for four marine mammal populations. Differences between values are discussed, and several issues relevant for the appropriate application of such value estimates are addressed. For example, do households have a specific value for each animal population versus marine mammals (or perhaps ecosystems) in general? Can households provide information on the value they attach to <u>incremental</u> changes in wildlife populations? If sampled households can provide valuations of losses of marine wildlife, are the responses representative of the affected population in the event of marine pollution, and what is the appropriate population over which to aggregate? For marine wildlife, does existence value exist?

APPLICATION OF THE CVM IN MARINE MAMMALS VALUATION

Analysis of the usefulness of the CVM for marine mammals valuation is based upon the results of a survey mailed from San Diego State University in 1984. The sample population was 1,000 California residents. Names and addresses were randomly chosen from telephone books according to the population distribution of the state (based upon the U.S. Census of Population 1980)—21.9% were sent to San Francisco/Oakland/San Jose, 48.6% to Los Angeles/Long Beach/Anaheim, 7.4% to San Diego County, 3.6% to Sacramento, 9.7% to other urbanized areas, and 7.6% to rural areas (places with less than 2,500 residents).

<u>Survey Description</u>

Following Dillman (1978), the survey procedure consisted of three mailings. The first included an introductory letter which outlined the purpose of the survey and assured confidentiality, a brief description/directions sheet, two descriptive sheets on the mammal groups to be evaluated, a questionnaire, two yellow answer sheets, and a self-addressed stamped return envelope. The second mailing was a reminder postcard sent to those households from which responses had not been received. The third mailing was another letter accompanied by a second copy of the survey materials.

The four species of mammals which were described to the respondents are representative of marine mammals in California. All surveys requested responses for bottlenose dolphins, California sea otters, and northern elephant seals. However, half of the surveys also asked respondents to provide responses for gray whales, whereas half were asked to answer for blue whales. The first whale population is quite abundant and can be viewed easily on whale watching tours or from the coast, whereas the second is quite rare (some researchers believe the blue whale population to be beyond recovery) and virtually impossible for anyone but researchers to observe. These four particular species were chosen in order to represent a spectrum of attributes--appealing versus unattractive (sea otters versus elephant seals), visible versus inaccessible, large versus small, familiar versus unfamiliar, endangered versus non-endangered.

In the descriptions of the four species, the following information was provided:

(1) A typical picture of one or more animals in the wild. Appealing pictures or textbook drawings were avoided in order to approximate a typical viewing experience.

(2) A small map indicating the range of each population.

(3) A scale of population levels and dates at which they have occurred in the past. For all mammals, the following scale applied:

A. a best estimate of the undisturbed population, before human activity. This scenario was dated to show when excessive hunting of the animal began off the Califoria coast.

B. an incremental increase in the population above current level C, but below the historical maximum A.

C. the 1984 population level which exists under protective legislation.

D. a population level which reflects a best estimate of the historical low number of animals when hunting was allowed. This "no protection" case was dated to provided information on what happened to the populations when hunting was unregulated. (This was not relevant for dolphins since the California population has not been hunted.)

(4) <u>History</u>: A brief discussion of the animals and information on whether or not they have been considered to be in danger because of human and/or natural causes.

(5) <u>Current population</u>: Estimates of the number of animals off the California coast and how these populations are changing.

(6) <u>Worldwide</u>: How the California population compares to the worldwide numbers of these animals. For example, are there many other animals of this same type found around the world? Or are most or all of this type of animal found along California's coast?

(7) <u>Seeing the animal</u>: How accessible the animals are for viewing and photographing in the wild. The respondent was referred to the map

which illustrates range. Also some rough figures were provided on the average number of animals per square mile of ocean near the shoreline within the range for ech of the situations A-D. The respondent was advised to use this information to get some idea of his/her chances of seeing the animals.

The questionnaire itself was divided into three parts--travel cost information, the CVM study, and socio-economic questions. In Part I, titled "Seeing the Animal," a brief orientation was provided in the introductory questions which ask respondents to report exposure to a species through communications media, captive display, or actual observation in the wild. (According to Dillman, as a means of encouraging respondents to continue, the first questions should be ones which require little effort and which will have "yes" answers for most people.) The remainder of this part attempted to identify travel behavior for respondents who reported recent observation in the wild; those who did not report recent observation were referred to Part II.

Part II, titled "Importance of the Animal," used the CVM to elicit valuation responses from both users (i.e., observers) and non-users. The responses to Part I and Part II were recorded on the first page of the yellow answer sheets. The respondents reread the questions in Parts I and II four times, answering all questions for whales first, then for bottlenose dolphins, California sea otters, and northern elephant seals. The answer sheet was divided into five columns. The first column gave brief instructions for each question, and each of the other columns provided answer spaces for the same questions asked for each of the four species. At the bottom of th answer sheet, a payment "bid card" (as suggested by Carson and Mitchell (1984) to allow respondents to focus on their bid without creating starting point bias) was provided for use in the WTP questions. Payment choices ranged from $0 to $200, with low values incremented by small amounts. Values from $20 to $100 were incremented by $5, and over $100 by larger amounts.

The second and final page of the answer sheets was entitled "About You." On this sheet, individuals were asked to provide confidential information on socio-economic variables: number of residents in the household, age and sex of respondent, employment and annual income, years of education, and whether or not hunting/fishing or membership in an environmental group applied to adult members of the household. Also, an "Avidity Scale" was described, on which respondents were asked to indicate their avidity on a 0-10 scale for each of the following: swimming, sailing, surfing, sunning at the beach; ocean activities which require a motorized boat; fishing for sport (shellfish and billfish) in the ocean; protection of ocean animal populations; protection of any animal population if endangered; and preservation of "wilderness" types of areas where no human development or machinery are allowed.

In the past, many valuation studies have utilized face-to-face interviews to collect data. However, budget constraints have led researchers to turn to mail and telephone survey techniques instead. Dillman (1978) describes a number of tested techniques which not only help to insure that interview bias does not result, but also enhance response rates. This survey incorporated many of these techniques; for example, each introductory letter was personally addressed and hand signed. Also, though budgetary limitations prohibited offering respondents any financial incentives for filling out their questionnaires, some incentive was provided by promising to send respondents a copy of the study results. However, Dillman also suggests the use of a booklet form for the questionnaire, ideally with an appealing cover illustration. Unfortunately, printing costs made this impractical for this CVM study. Because several species were of interest, a booklet would have been quite large if questions were repeated several times so that answers could be made on the booklet. Thus, it seemed more reasonable to use one questionnaire for all species, and employ one answer sheet which also made clear the idea that four different species were being valued but the approach was the same in all cases.

Methodological/Theoretical Issues

The initial contingent valuation questions are shown below. The individual is referred to the description sheets for the animal population and asked to state a willingness-to-pay amount to avoid moving from the current Situation C to Situation D. The payment vehicle of an earmarked fund was chosen to avoid the negative connotations which generally attend tax payments. Since we are referring to free roaming animal species, a user fee did not seem to be an appropriate payment vehicle, especially since it was not expected *a priori* that all households would have observed or plan to observe all of the species in the wild.

PART II. IMPORTANCE OF THE ANIMAL

Please answer the following questions *whether or not* you have seen this animal in the wild or elsewhere. Some people believe that hunting (if allowed), pollution and fishing nets in the ocean could destroy many marine mammals. Some people even believe that without protection these animals might not survive in the ocean off the California coast. This animal is protected by government programs which, of course, have costs. The following questions are designed to find out how much your household values protection of this animal.

9. Please look at the chart shown on the left-hand side of the Description Sheet for this animal. The level marked *C* shows the current population size. Assume for a moment that this animal is no longer protected from hunting or other types of damage. Assume also that without protection, the population would fall to situation *D*. This would, of course, decrease your chances of seeing the animal and could also endanger the population. Please look over the descriptions about the animal as you think about moving from *C* to *D*. Suppose that the *only* way to avoid Situation *D* is if households were willing to contribute to a fund specifically used for this purpose. Suppose also that *each* household in the nation were required to pay the *average* amount of all households' answers to the following question, rather than the actual amount of your response. What would the *maximum* amount (in dollars) your household would be willing to pay *per year* into the fund to protect this animal and prevent Situation *D*? PLEASE CHOOSE YOUR ANSWER FROM THE *PAYMENT CHOICES* SHOWN AT THE BOTTOM OF THE YELLOW ANSWER SHEET.

10. Suppose a survey such as this was conducted, but the average response to Question 9 did not provide enough funds to prevent Situation D. Please look at the payment choices at the bottom of the yellow answer sheet and indicate any additional amount over and above your response to Question 9 which your household would be willing to pay at most per year into the fund to prevent Situation D.

11. Your maximum yearly payment is found by adding together the numbers you gave in Question 10. Please write this total next to #11 on your answer sheet.

The questionnaire was structured to avoid several potential problems. The discussion below addresses several areas about which criticisms of the CVM have been raised due to the potential for bias.

Strategic Behavior

To reduce the likelihood of strategic behavior in the reporting of valuations, an incentive-free payment mechanism was introduced. Respondents are asked to report annual WTP for their households, given that the actual payment would be an average of all respondents valuations. Furthermore, to encourage true revelation of preference and avoid free riding behavior, the stipulation was made that all individuals would be required to contribute this amount in the hypothetical situation.

Even so, some strategic behavior could still exist on the part of individuals who strongly favor or disfavor the public good. Therefore, one reason for collecting socio-economic data later on in the survey is to enable us to identify outliers when the results are analyzed. This allows for some control on the few respondents who may attempt to behave strategically. Rational individuals who are not behaving strategically may be expected to report a maximum WTP which reflects perceived benefits at the margin. Perceived benefits, or utility can be expected to be a function of income and perhaps other variables. For example:

U(income, location of residence, family size, age, occupation, education, previous exposure to marine mammals or other wildlife, avidity for marine recreation and/or wildlife conservation, etc.)

If econometric analysts indicates that an individual's WTP deviates significantly from the reported WTP of individuals with similar socio-economic characteristics, this may indicate strategic behavior and this data point can be removed (see Section V for a detailed discussion of this procedure).

However, as noted previously, strategic behavior is rarely identified in CVM studies. (For example, in a CVM study by Brookshire in which campers were asked to state their WTP to preserve a recreational site, the only case of strategic behavior appeared to be an economist who happened to be vacationing at the site with his family.) Generally, we would expect people to have little incentive to report biased WTP due to the hypothetical nature of the questions.

Hypothetical Bias

The willingness-to-pay questions were structured to provide as much consequence realism as possible. Population characteristics (threatened/endangered status accessibility for viewers, uniqueness, range) were described in order to determine if respondents take such information into account when stating valuations for different species of mammals.

The first question, willingness-to-pay to avoid deterioration from the current Situation C to Situation D was based upon historical evidence of drastic reductions in the respective marine mammal populations when protection was neither funded nor enforced. To further encourage participants to provide considered WTP responses, individuals were asked to consider all monthly expenses (utilities and home expenses, entertainment, food and clothing, education, or charity) when making a final valuation estimate. This was included to counter a criticism of the CVM that individual's values are estimated in partial equilibrium.

The willingness-to-pay response to prevent deterioration from C to D can be depicted graphically using indifference curve analysis, as shown in Figure 2. If environmental degradation (reduction in marine mammal populations) is depicted along the horizontal axis, and (B_1, G_1) represents an individual's current position on indifference curve I_0, then the maximum WTP to prevent deterioration to X_1 is Y_1-Y_0, an equivalent variation measure (EV_D) for the same change in environmental quality. Thus, it is valid to state the willingness-to-pay question in terms of either the deterioration or improvement situation since the magnitude of the stated value will be the same in either case.

In the marine mammals's survey, two additional questions were asked to determine respondents' willingness-to-pay to attain incremental increases in each species above current population levels. The increases described were related to historically high population levels that existed before excessive hunting ensued. These questions were meant to provide further information on whether individuals' answers appeared to be based upon consideration of the situations, or were simply random due to the hypothetical nature of the survey.

Note also the relationship between the willingness-to-pay and willingness-to-accept measures in Figure 2. Since $EV_D = CV_1 \leq EV_1 = CV_D$, we avoided the use of WTA questions since individual property rights for marine mammals do not exist and the use of WTA would have increased the hypothetical nature of the survey.

Lastly, we attempted to gather information on respondents' travel experiences to observe the marine mammal populations off the coast of California. These data can be used to conduct a travel cost study for purposes of comparison with CVM estimates, thus helping to dispel claims that the willingness-to-pay estimates suffer from hypothetical bias.

Starting Point Bias

Rather than use a starting point, individuals were asked to choose from a "payment card" shown at the bottom of the answer sheet. Initial WTP was

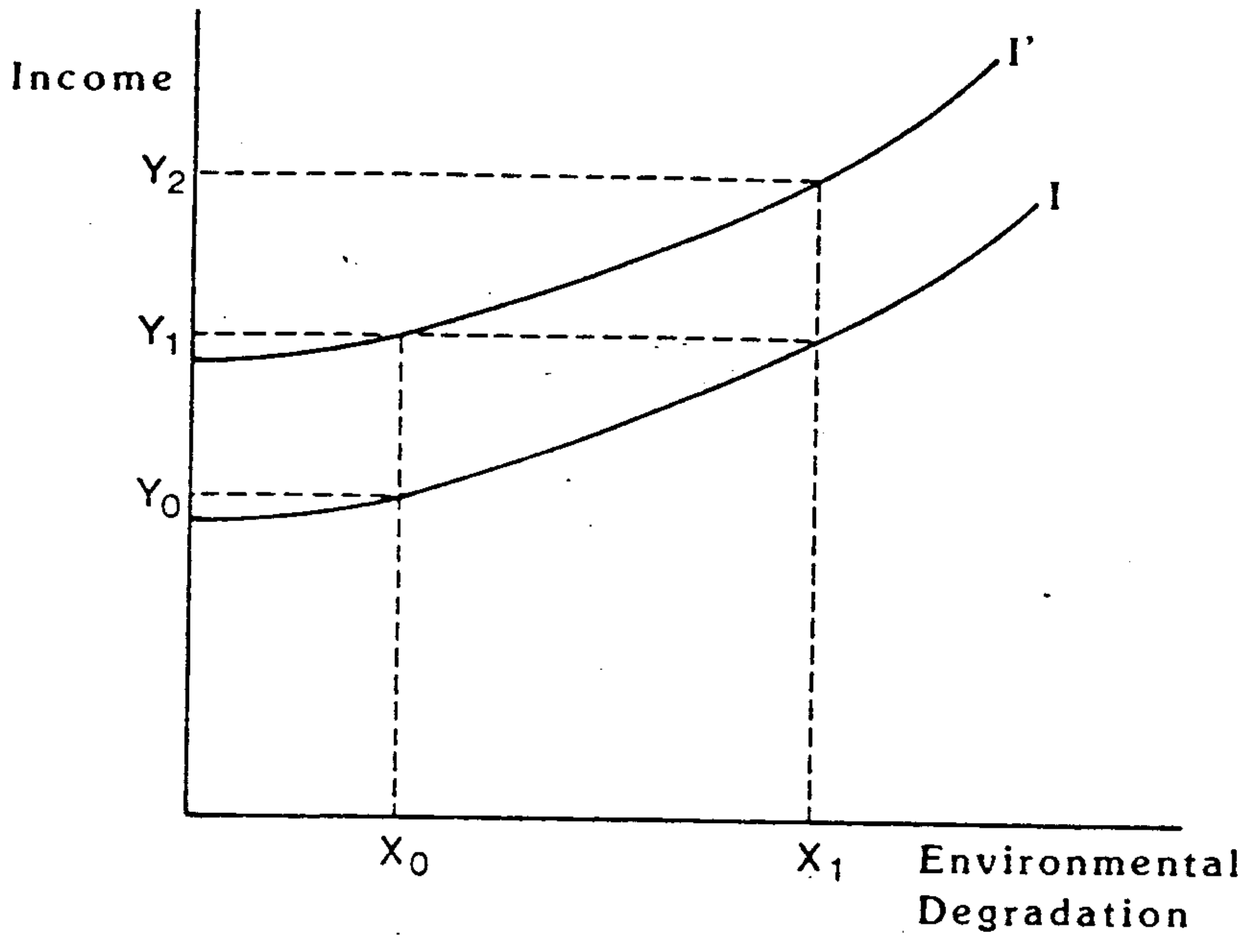

Figure 2. Comparison between willingness-to-pay and willingness-to-accept for changes in environmental quality.

Deterioration: $X_o \longrightarrow X_1$

Maximum WTP = EV_D = $Y_1 - Y_o$
(property rights do not rest with respondent)
Minimum WTA = CV_D = $Y_2 - Y_1$
(property rights rest with respondent)

Improvement: $X_1 \longrightarrow X_o$

Maximum WTP = CV_I = $Y_1 - Y_o$
(property rights do not rest with respondent)
Minimum WTA = EV_I = $Y_2 - Y_1$
(property rights rest with respondent)

then "pushed" to the maximum as in a bidding process. Values ranged from $0 to $200, with increments as shown:

Payment Choices:							
$0	$1.00	$10	$25	$45	$65	$85	$110
.10	2.00	12	30	50	70	90	120
.25	5.00	15	35	55	75	95	150
.50	7.50	20	40	60	80	100	200

Payment Vehicle Bias

In order to avoid protests due to use of increased tax payments as a payment vehicle, individuals were asked to state WTP into a preservation fund to be used to protect marine mammals.

Information Bias

Given our desire to encourage a higher response rate by limiting the survey's length, we provided as much informatin on each species as one-half page would allow. This included the historical setting, population status and location, potential for siting, and a picture of the animal. Every effort was made to avoid making sympathetic statements about endangered species or to show aesthetically appealing pictures/scenes which would not be viewed in actual sitings in the wild.

Protests

Aside from individuals who wrote to say they could not or would not respond, we also used the following question to identify protest bids:

12. On the first yellow answer sheet, please circle the answer from the choices below which best describe your reason for responding to Questions 9 and 10 as you did.

    A. CHOSE BEST ESTIMATES OF WHAT SHOULD BE PAID TO PREVENT SITUATION D.
    B. DO NOT FEEL WE SHOULD PAY, BUT THE GOVERNMENT SHOULD.
    C. THE FUND DESCRIBED IS AN INAPPROPRIATE WAY TO PROTECT THIS ANIMAL.
    D. COULD NOT AFFORD ANY MORE.
    E. UNWILLING TO ESTIMATE DOLLAR AMOUNTS EVEN THOUGH HOUSEHOLD VALUES THIS ANIMAL.

Those respondents who stated a zero WTP, and also answered "B," "C," or "E" were identified as protestors and were removed from the sample.

ANALYSIS OF RESULTS

In response to the first mailing and follow-up reminder cards, 121 questionnaires were completed and returned. After the final mailing in which a second copy of the questionnaires was enclosed for individuals who had not yet responded, a total response rate of 21% was achieved. Of this total, eleven were identified as protests either by the response to the control question or by the respondent's written explanation. (This included some, but not all, of the zero WTP responses received). Fourteen individuals either misunderstood the questionnaire or filled out only portions of it.

There remain 180 usable responses for whales (93 gray and 87 blue), 175 for dolphins, and 174 for sea otters and elephant seals (i.e., some individuals filled out their questionnaire for only some species, leaving the others blank).

Contingent Valuation Responses

Missing values for all variables except the WTP data were replaced by estimates derived by using the modified first order regression method for estimating missing observations. Madalla (1977) reports this is the preferable method when the correlation between variables is less than 0.5. A preliminary inspection of the correlation matrix without missing observations indicated low correlation values. The value of the maximum WTP per year per household (question #11) adjusted by reported values for #14a (adjustment to WTP after discussing income constraints) is used as the final WTP estimate. Means and standard deviations for WTP were calculated for each of the four species, by survey group (blue whales or gray whales in the first column). The eight groups were viewed separately at first to determine whether the effect of having blue whales versus gray whales resulted in statistically different responses for each of the four species. Mean values with standard deviations are reported in Table 1.

Table 1. MEAN WTP/YEAR PER HOUSEHOLD, BY SURVEY GROUP

Gray Whales first
n=93

	Gray Whales	Bottlenose Dolphins	Sea Otters	Elephant Seals
Mean	$26.98	$22.00	$26.12	$21.69
Standard Deviation	49.10	43.61	45.38	41.46

Blue Whales first
n=87

	Blue Whales	Bottlenose Dolphins	Sea Otters	Elephant Seals
Mean	$28.78	$23.16	$24.97	$23.13
Standard Deviation	52.56	48.26	48.40	49.06

Using Student's t-tables, equality of means by species was tested with the following results (t-statistics, degrees of freedom are shown in parentheses below):

H_0: Gray Whales = Blue Whales (-0.237,178)

H_0: Dolphins = $Dolphins_B$ (-0.167,173)

H_0: Sea Otters = Sea Otters (-0.162,172)

H_0: Elephant Seals = Elephant $Seals_B$ (-0.21,172)

In all cases, the null hypotheses are accepted at a confidence level greater than 99%. Data were then pooled into four groups, by species.

Since some previous analyses of the results of mail surveys have provided evidence that responses from follow-up mailings do not affect the results derived from responses to initial mailings (see Goudy 1978 and Wellman et al. 1980), we compared the WTP responses and the answers to socio-economic questions from the first 121 respondents (Data Set 1) to the responses received after the final mailing (Data Set II). Because there is no reason to believe a priori that the two data sets are not independent samples, a t-test was performed on the difference in means for each species in the early data set and late data set. The results shown in Table 2 indicate that the responses received after the final mailing were not statistically different (confidence interval exceeding 99%) than those received earlier. Furthermore, responses to socio-economic characteristics in Data Set I were compared to those in Data Set II. For every variable, a t-test on the difference in means indicated that the socio-economic characteristics of early respondents were not statistically different than the characteristics of later respondents. However, in order to decrease the chances of making a Type I or Type II error, the entire sample was used for analysis in the discussion which follows.

Table 2. MEAN WTP/YEAR PER HOUSEHOLD, BY RESPONSE GROUP[a]

	Whales Blue and Gray		Bottlenose Dolphins		California Sea Otters		Northern Elephant Seals	
	I	II	I	II	I	II	I	II
Mean	$28.98	$26.15	$25.86	$17.62	$27.63	$22.49	$25.03	$18.46
Standard Deviation	56.58	40.54	56.11	22.43	57.09	24.37	55.82	20.89
t-statistic[b] (degrees of freedom)	.37 (178)		1.17 (173)		.71 (172)		.94 (172)	

[a] Response Set I received after initial mailing and reminder; Response Set II received after final mailing.

[b] The null hypothesis, $mean_I = mean_{II}$, is rejected for $t \geq 2.617$ (99% confidence).

Mean responses to the initial willingness-to-pay question (#9) are shown in Table 3 for the four species. These values reflect the initially stated annual WTP per household.

Table 3. INITIAL BID[a]

	Whales Gray and Blue	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals
Mean	$16.29	$13.90	$15.47	$13.57
Standard Deviation	27.12	25.68	26.69	25.02

[a] Responses to question #9. (See the survey, Appendix to Chapter IV.)

In order to investigate the bidding behavior of respondents, t-statistics were estimated, by species, to determine if the mean response to question #10 is significantly different from zero. This question asked the respondent to state any amount he/she would be willing to pay over and above the WTP stated initially in order to assure the present situation (marine mammal protection) as opposed to the no protection scenario. The t-statistics are reported in Table 4. Furthermore, a similar test was performed on responses to #14a, the bid adjustment after the respondent's income constraint is discussed as follows:

14. Consider for a moment your household's budget. Some of the expenditures which you are currently making would hae to be reduced if you made your payment in Question 11 to prevent Situation D. With this in mind, would you like to revise your payment into the fund?

    If NO, skip to Question 15.

    If YES:

14a. Looking at the payment choices on the bottom, how much would you like to revise your payment? (For example, +50 cents/year or -$1.00/year.) Please continue to Question 15.

15. If your household is still choosing to pay some amount into the fund for this animal, which of the following budget categories would you reduce in order to pay into the fund?

    A. Utilities and home expenses
    B. Entertainment
    C. Food and clothing
    D. Educational expenses
    E. Charity contributions to other causes

Table 4. ADJUSTMENTS TO BID[a]

	Whales (Gray and Blue)		Bottlenose Dolphins		California Sea Otters		Northern Elephant Seals	
	#10	#14A	#10	#14A	#10	#14A	#10	#14A
Mean	+$12.34	-$ .77	+$ 9.29	-$ .62	+$ 9.96	+$ .13	+$ 9.23	-$ .42
Standard deviation	27.59	7.22	22.74	6.28	22.67	7.86	22.63	4.61
t-statistic[b]	6.0	1.4	5.4	1.3	5.8	.2	5.4	1.2
(degrees of freedom)	(179)		(174)		(173)		(173)	

[a] See questions #10 and #14A in the survey, Appendix to Chapter IV.
[b] The null hypothesis, that the mean value shown is significantly different from zero, is rejected for $t \geq 2.617$ (99% confidence).

Inspection of Table 4 reveals that the original willingness-to-pay is, in fact, much smaller than maximum willingness-to-pay (#9 and #10) (elicited by the question: "Suppose... the average responses... did not provide enough funds to prevent Situation D... Please indicate any additional amount over and above your (initial) response...") Previous studies (Schulze, Brookshire et al. (1983), Desvousges et al. (1983) and Burness et al. (1983), for example) have observed the same result, so that we conclude that the "bidding process" is important if the CVM is to provide evidence on maximum WTP. Furthermore, though the introduction to the household budget (Question 14) did result in some apparent decrease in WTP for each species, except sea otters, it turns out that these adjustments were not statistically different from zero. This result has been observed in previous studies (Burness et al. 1983 and Schulze, Brookshire et al. 1983). It can be viewed as some evidence that individuals provide considered information on their valuations to the preceding maximum WTP question under contingent conditions. In Cummings et al. (1984), it is suggested that finding this result is evidence that the application of CVM indicates that the WTP response is a "preference-researched bid" rather than a random number, and that income/commodity trade-offs were considered by respondents when they offered responses. Although this is not a complete counter to the issue of hypothetical bias, it does provide some evidence of introspective reporting of individuals' WTP values for marine mammal protection.

In order to include the preferences of those respondents who made adjustments to the WTP estimates, the adjusted value (Q11 $\pm$ Q14a) is retained for the remainder of this analysis. The correlation matrix for WTP and the socio-economic variables for one mammal group (results were similar across species) are shown in Table 5. The following variables are defined as:

$$EXP = 1 + 2 + 3 + 4$$

$$AVM1 = (AV26 + AV27 + AV28)/3$$

$$AVM2 = (AV29 + AV30 + AV31)/3$$

These are indices, where EXP represents exposure to the mammal through the media, captive display, and on-site observation. This is the sum of the respondent's answers to Questions 1, 2, 3, and 4, where yes = 1 and no = 0. The two average measures of avidity, AVM1 and AVM2, are indices of enthusiasm for marine recreation and wildlife/nature conservation, respectively. AVM1 is the average of responses on the 0-10 scale in Questions 26-28; AVM2 is the average of responses on the 0-10 scale in Questions 20-31. Zero represents no avidity and 10 represents extreme avidity.

Table 5: CORRELATION MATRIX, WHALES, (GRAY AND BLUE)

	WTP	EXP	Miles	Fam.Sz	Age	Sex	Income	Educ.	Hunt/Fish	Env.Org.	AVM1
WTP	1.										
EXP	.09	1.									
Miles	-.04	-.10	1.								
Fam.Sz.	-.05	.02	.03	1.							
Age	-.15	.02	.02	-.01	1.						
Sex	.05	-.14	.11	.13	.08	1.					
Income	.09	-.04	-.05	-.43	-.12	-.11	1.				
Education	.12	.03	-.14	.16	-.18	-.19	.22	1.			
Hunt/Fish	-.01	-.04	.15	.25	.23	-.01	-.10	-.22	1.		
Env. Org.	.09	.12	.06	-.23	.21	-.01	.03	.21	.02	1.	
AVM1	.16	.13	-.09	-.06	-.31	-.06	.01	.09	.37	.03	1.
AVM2	.24	.20	-.06	.03	.06	.04	.19	-.14	-.05	.33	.36

Inspection of Table 5 provides some information about the impact of the socio-economic characteristics on maximum WTP. Exposure to the mammals, avidity for marine recreation, and membership in environmental groups have very low, positive correlations with the willingness-to-pay responses. Mileage to the coast (the horizontal distance from city center of residence to the coastline) has an extremely low, negative correlation with WTP. Avidity for wildlife/nature conservation is somewhat more correlated with WTP, but the value, though positive, is still quite low. Even income and education have fairly low correlations with WTP (though presence of outliers could be affecting this relationship). Age is negatively correlated with WTP possibly due to the impact on WTP of responses by retired persons on fixed incomes.

Before proceeding with a discussion of the maximum WTP estimates, we must address the common criticism that some individuals who strongly favor or disfavor the public good being valued may have attempted to bias the results when reporting their WTP values. Even if we argue that the hypothetical nature of the study reduces the incentive for such intentional behavior, it is this hypothetical nature which could instead cause individuals to mistakenly misstate their true willingness-to-pay. A way to reduce these possibilities is to identify probable outliers in the data set and remove those responses.

One method might be to simply eliminate observations which lie some X (say 10) standard deviations from the mean. However, this adjustment to the sample seems rather arbitrary and does not allow for any consideration of the respondent's characteristics (which could affect her/his stated WTP) relative to other respondents in the sample.

In this study, identification of likely outliers is accomplished by using a diagnostic technique suggested by Belsley, Kuh and Welsch (1980). Use of the technique requires first, regressing explanatory socio-economic variables on the WTP estimates for all observations. In CVM studies, application of ordinary least squares (OLS) regression analysis to estimate WTP has generally yielded R^2 values of 0.3 or less using cross-sectional data. The reason these regressions have little explanatory power is that utility functions which determine values for public goods tend to be highly individualized. In our example, we might hypothesize that residents nearer to the coastline would value marine mammals more highly than inland residents. However, there may be many inland residents who value the mountains and undeveloped nature, so that they too report a high value for species in general, including marine mammals. Thus, we would expect a variable like miles from the coast to have negative coefficient when regressed on WTP, but it may not have a strong or even statistically significant effect.

However, if an OLS regression has some theoretical justification (e.g., income has been shown to affect WTP in many previous CVM studies), it can be used to identify outlying observations. Belsley, Kuh and Welsch have developed a statistic which essentially re-estimates the coefficients in the WTP equation sequentially without each observation. If an observation significantly changes the coefficient, that response is identified as a likely outlier. This technique has been applied in two previous CVM analyses, (Desvousges et al. (1982) and Brookshire et al.(1984)). It seems an essential step since the possibilities of strategic behavior or hypothetical bias could result in incorrect valuations reported by some respondents.

After performing an OLS regression on the maximum WTP responses for each species, we calculated (nxm) B-K-W statistics, one for each variable and each respondent on a particular species. Because economic theory supports the notion that WTP should be determined, to some extent, by income we used the B-K-W statistics on income as our gauge to identify outlying observation. Following Desvousges et al. (1982) and Brookshire et al. (1984), the B-K-W statistic for a particular observation divided by the regression coefficient on income exceeded 0.3, the observation is labeled a likely outlier. The interpretation is that the B-K-W statistic indicates that this observation alone caused a change in the coefficient on income in excess of 30%. The 30% gauge was a natural cut-off point in this study, since almost all coefficients were affected by less than 20% for all variables.

For all species, the same two individuals' responses were identified as outliers. In addition, a third respondent was identified as an outlier in the dolphin and sea otter data sets. In other studies utilizing this technique, some outliers were identified which had WTP values very near the mean (i.e., if a respondent's stated WTP was extremely unusual given his/her socio-economic make-up relative to similar types of respondents); however, in this study the outliers identified were, in fact, only the very high bids received. (For example, one respondent who bid $400/year wrote to say that the individual was strongly in favor of wildlife conservation, but expressed concern that similar households would respond by over-estimating true WTP.)

In Table 6, results of the OLS linear regression procedures are shown for the independent explanatory variables before identification of outliers and then after outliers have been removed from the data set. Based upon a preliminary inspection of the correlation matrices, the following variables were included:

WTP = f(EXP, MC, FSZ, AGE, Y, AV2)

where:
- WTP = Q11 $\underline{+}$ $\underline{\text{Q}}$14a
- EXP = exposure to the animals through the news media, captive display, or on-site observation
- MC = mileage of town of residence to the California coast
- FSZ = family size; number of residents in the household
- AGE = age of respondent
- Y = annual household income
- AVM2= avidity index for species preservation/conservation

Table 6. ESTIMATED COEFFICIENTS, OLS REGRESSIONS
DEPENDENT VARIABLE=WTP (Q 11+Q 14A)
(t-values in parentheses).

	Whales (Gray and Blue)		Bottlenose Dolphin		California Sea Otter		Northern Elephant Seals	
	All Data	Without Outliers	All Data	Without Outliers	All Data	Without Outliers	All Data	Without Outliers
Constant	4.89	.96	4.94	-3.22	4.58	-1.28	2.65	4.77
EXP	2.27	.84	4.33	3.65*	4.60*	3.04*	5.72*	1.57*
	(.68)	(.43)	(1.58)	(2.64)	(1.77)	(2.16)	(2.38)	(1.21)
MC	-.003	.001	-.419	-.54	-.05	-.01	.03	.03
	(-.27)	(.16)	(-.38)	(-.98)	(-.46)	(-.20)	(.28)	(.47)
FSZ	-2.96	-1.34	-2.97	-1.20	-4.11*	-2.26*	-2.28	-1.16
	(-1.14)	(-.76)	(-1.25)	(-1.01)	(-1.69)	(-1.72)	-.97)	(-.92)
Age	-.57*	-.37*	-.45*	-.19*	-.45*	-.21*	-.44*	-.24*
	(-2.33)	(-2.17)	(-1.97)	(-1.71)	(-1.98)	(-1.65)	(-1.94)	(-1.99)
$Y_{10,000}$	3.11*	3.13*	1.65	1.58*	1.78	1.67*	1.42	1.45*
	(1.88)	(2.76)	(1.09)	(2.09)	(1.14)	(1.98)	(.94)	(1.79)
AVM2	5.53*	4.00*	3.86*	2.41*	4.72*	3.36*	3.96*	2.54*
	(3.58)	(3.79)	(2.69)	(3.34)	(3.37)	(4.26)	(2.90)	(3.46)
Degrees of freedom	173	171	168	165	167	164	167	165
R^2	.08	.10	.07	.13	.08	.12	.03	.08

*Significant at the 95% levels, t>1.645.

The other avidity type of variable, such as membership in environmental organizations and AVM1 were not included because they did not appear to affect WTP. Furthermore, they may be measuring the same effect as AVM2. The education variable was not included because, on theoretical grounds, it is too closely associated with income and could cause multicollinearity.

All data except miles to coast were taken directly from the returned answer sheets. Miles to coast were determined to be the horizontal map distance from the respondent's town of residence to the California coastline. A priori, we would expect exposure, income, and avidity to have a positive effect on WTP, and inspection of Table 6 reveals this to be the case. Family size decreases WTP, perhaps because it lowers per person income. (Inclusion of Y/FSZ rather than Y reduced the explanatory power of the equations.) As age of the respondent increased in this data set, WTP was reduced. This could be the result of having several retired individuals in the data set on fixed incomes. The coefficient on mileage to the coast has a negative sign, but it is never a significant variable based upon the t-statistics shown.

As shown in Table 6, removal of likely outliers resulted in an improved R^2 and also a statistically significant coefficient on income, as we would expect intuitively. Although the high standard error which results from the use of a cross sectional data set such as these does not allow use of these regression results to predict bids, the procedure does allow the removal of likely outliers, which enhances the reliability of the WTP estimates derived from the remaining data. In Table 7, a profile of the likely outliers is shown. For purposes of comparison, mean values for the remaining data set are provided in Table 8. Below, an index is provided for the questions for which mean response values are shown in Tables 7 and 8.

Exp. 1:	journalistic media exposure to the animal yes = 1; no = 0 (whales, dolphins, sea otters, elephant seals)
Exp. 2:	exposure to live animals in captive display yes = 1; no = 0 (whales, dolphins, sea otters, elephant seals)
Exp. 3:	exposure to the animals in the wild yes = 1; no = 0 (whales, dolphins, sea otters, elephant seals)
Exp. 4:	exposure to the animals in the wild off California coast in 1983 yes=1; no = 0 (whales, dolphines, sea otters, elephant seals)
MC:	number of miles residing from the California coast
Fam.Size:	number of residents in the household
Age:	age of respondent
Sex:	sex of respondent female = 1; male = 0
Income:	annual household income
Education:	respondent's years of education
Hunt/Fish:	any hunting/fishing done by a household member? yes = 1; no = 0
Env.Org.:	any resident a member of environmental organization?
AV26-28:	Avidity scales for non-fishing and fishing marine recreation 0 = none; 10 = extreme avidity
AV29-31:	Avidity scales for species conservation and wilderness preservation 0 = none; 10 = extreme avidity

Table 7. RESPONSES OF LIKELY OUTLIERS

	OUTLIER I				OUTLIER 2				OUTLIER 3[a]			
Responses	W	B.D.	S.O.	E.S.	W	B.D.	S.O.	E.S.	W	B.D.	S.O.	E.S.
WTP/Year	350,	350,	350,	350	400,	400,	400,	400	150,	150,	150,	100
Exp. 1	yes,	yes,	yes,	yes	yes,	yes,	yes,	yes	yes,	yes,	yes,	yes
Exp. 2	no,	yes,	yes,	yes	yes,	yes,	yes,	yes	yes,	yes,	yes,	yes
Exp. 3	yes,	yes,	yes,	yes	no,	no,	no,	yes	yes,	yes,	yes,	yes
Exp. 4	no,	no,	yes,	no	no,	no,	no,	no	no,	no,	no,	yes
Miles to Coast		15				15				6		
Fam. Size		3				1				3		
Age		32				33				25		
Sex		Female				Male				Female		
Income		$50,000				$15,000				$50,000		
Education		18 yrs				19 yrs				12 yrs		
Hunt/Fish		no				no				yes		
Env. Org.		no				no				no		
AV26		10				10				7		
AV27		1				0				9		
AV28		0				0				3		
AV29		10				10				7		
AV30		10				10				5		
AV31		10				10				5		

[a] An outlier for sea otter and dolphin sets only.

Table 8. MEAN VALUES: WTP AND SOCIO-ECONOMIC CHARACTERISTICS (OUTLIERS REMOVED)

Variables	Whales	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals	Standard Deviatio (Weighted Average
WTP/Year	$23.95	$17.73	$20.75	$18.29	$28.39
Exp. 1 (yes=1)	.78	.79	.80	.59	.43
Exp. 2 (yes=1)	.29	.82	.63	.47	.45
Exp. 3 (yes=1)	.35	.47	.53	.31	.49
Exp. 4 (yes=1)	.16	.17	.25	.10	.37
Miles to Coast	22.8	23.0	22.9	22.5	30.61
Family Size	2.67	2.67	2.69	2.68	1.45
Age	42.5	42.3	42.3	42.2	15.1
Sex (0=Male)	.39	.38	.39	.39	.49
Income ($/Year)	$35,302	$35,314	$34,994	$35,081	$22,739
Education (years)	15.3	15.4	15.4	15.3	2.87
Hunt/Fish (0=no)	.39	.37	.37	.38	.40
Env. Org. (0=no)	.19	.18	.18	.18	.40
AV26 (0-10)	5.5	5.5	5.6	5.6	3.2
AV27 (0-10)	2.6	2.5	2.5	2.6	3.1
AV28 (0-10)	2.0	2.0	2.0	2.0	2.7
AV29 (0-10)	6.9	6.9	6.9	6.9	2.7
AV30 (0-10)	7.3	7.3	7.3	7.2	2.6
AV31 (0-10)	7.8	7.8	7.7	7.7	2.6

The response data in Table 8 warrant some discussion on the ability of surveys to elicit information about WTP to protect specific wildlife groups. Familiarity with the animals through communications media (Exp. 1) is quite high, near 80% of all groups except the northern elephant seal about which only 60% had previous information. Of interest are the number of "yes" responses to the other three exposure categories. For whales, 30% of the respondents reported seeing gray or blue whales in live captive displays, and 47% reported having seen northern elephant seals. The former is impossible and the latter highly unlikely. Furthermore, while reporting of 1983 on-site sitings of dolphins and sea otters (Exp. 4 = 23% of respondents) is reasonable, some of the individuals who sited whales were those with blue whale questionnaires. Also, 23% reported on-site observation of northern elephant seals. Again, the two latter sitings are highly improbable for anyone but trained biologists. Thus, if we believe respondents are attempting to answer honestly, we might hypothesize that they are able to distinguish by sub-orders, since the pictures and information supplied should allow respondents to group animals into categories such as whales, dolphins/porpoises, sea otters, and seals/sea lions. However, at least some respondents are either unable or unwilling to make the more narrow species distinction (e.g., northern elephant seals) requested in this survey.

The socio-economic profile of survey respondents is similar to that of average Californians. Based upon 1980 Census figures, average household size is 2.68; for our respondents, the average is 2.67. Average age of the respondents is about 42 years; this compares to an average of 43.5 for the adult (over 19) population of California, as reported in the California Almanac (Fay et al, 1984). Average income per family for 1984 in California is $32,602/year (again, inflating 1980 Census figures to 1984 dollars). Therefore, the average income of the survey respondents, approximately $35,000 per year, is near that of the general population of the state. Average education of respondents is 15.3 years (± 2.9), compared to a statewide average of 12.4 years in 1980. Again, the survey respondents exhibit a similarity to the general population of California.

The information gathered on avidity shows that the mean response to the questions about enthusiasm for marine recreation activities (AV26 - 28) is at or below the mid-point of 5. Mean avidity responses for wildlife/wilderness preservation (AV29-31) were above the midpoint but below the maximum. In order to make comparisons between respondents' and average Californians' avidity for marine recreation/resources, a telephone survey was conducted. An independent sample of 425 California households was chosen, distributed over all areas of the state population of California. Respondents to the telephone survey answered questions only related to avidity, as shown below:

"Hello,

My name is ____________________. I'm a student at San Diego State University, and I'm working on a project to find out how Californians feel about ocean resources and recreation in our state. If you don't mind, I'd like to ask your opinion on six questions. It will only take two or three minutes of your time.

Picture a scale from 0 to 10 on which you can rank your avidity (desire or enthusiasm) for the things I'll describe. 0 means no avidity. 10 means extreme avidity. 5, of course, is something in between the two extremes.

On this scale, please give me the number from 0 to 10 you'd choose to represent your avidity for:

Q-1 Swimming, sailing, surfing, and sunning at the beach, 0 to 10?
Q-2 Ocean activities which require a motorized boat, 0 to 10?
Q-3 Fishing for sport in the ocean (for example, shellfish and billfish), 0 to 10?
Q-4 Protection of ocean animal populations, 0 to 10?
Q-5 Protection of any animal population if it is endangered, 0 to 10?
Q-6 Preservation of wilderness types of areas, 0 to 10?

That's the last question. Thank you very much for your time."

No mention of marine mammals was made so that responses would reflect general avidity for the activities/issues discussed. However, the six questions asked were identical to the last six questions (26-31) on the mail survey. Eighty-three percent of the households called were at home; of these, 71% answered all six questions. The following averages from 250 Californians' responses were obtained.

	Telephone Survey		Mail Survey	
	Mean	Standard Deviation	Mean	Standard Deviation
AV26	7.1	2.9	5.5	3.2
AV27	4.9	3.4	2.6	3.1
AV28	5.3	3.6	2.0	2.7
AV29	8.8	1.9	6.9	2.7
AV30	9.2	1.7	7.3	2.6
AV31	9.1	1.5	7.8	2.6
AVM1 (Average of 26, 27, 28)	5.8 1	2.6 1	3.4 1	3.0 1
AVM2 (Average of 29, 30, 31)	9.1	1.5	7.3	2.6

Hypothesis tests for equality of means between the two surveys indicate that the mean avidity values reported in the mail survey are not statistically greater than the mean values for avidity stated in the telephone survey (greater than 99% confidence for all questions). This result provides further evidence that the respondents who mailed their valuations for marine mammals are no more avid about marine resources or environmental protection than the typical alifornia household.

Data on the miles to coast variable were not provided by the respondents. These were calculated by estimating the horizontal distance from city centers of residents in the sample to the California coastline. At the outset of the study, every effort was made to draw survey names from cities and towns around the state based upon the total population distribution. For the surveys mailed, the miles to coast from city centers averaged 21.8 miles, largely due to the fact that 78% of the population lives in the San Francisco, Los Angeles, or San Diego Areas.

Although information on the average distance of residence from the coast for all California residents is not readily available, we were able to tabulate what proportion of the population lives within 100 horizontal miles from the coast. It turns out that 95.7% of Californians reside in cities whose centers are 100 horizontal miles from the coast, whereas 99.1% reside within 130 miles from the coast. This is relevant for our study because over 12% of the respondents who returned completed questionnaires lived in excess of 70 miles from the coast, and maximum mileage was 130 miles (3 respondents).

In Table 9, the means and standard deviations of the maximum WTP responses are shown, stated by respondents as the amount per household per year. These are the values after likely outliers have been identified and removed using the B-K-W procedure discussed above. For purposes of comparison, the values for the entire data set are shown in parentheses. When outliers are removed from the data set, mean WTP estimates decline somewhat with a rather dramatic decrease in their standard deviations. This reduces the coefficient of variation (standard deviation divided by expected value) by 22% for whales, about 33% for dolphins and elephant seals, and 50% for sea otters.

Table 9. MEAN WTP/YEAR[a] PER HOUSEHOLD, (OUTLIERS REMOVED[b]

	Whales (Blue and Gray)	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals
Mean	\$29.95 (\$27.85)	\$17.73 (\$22.57)	\$20.75 (\$25.56)	\$18.29 (\$22.39)
Standard Deviation	34.82 (50.67)	23.58 (45.80)	25.77 (46.73)	24.19 (45.16)
Number of Observations	178 (180)	172 (175)	171 (174)	172 (174)
t value[c]	9.18	9.83	10.52	9.89
Maximum	\$250 (\$400)	\$135 (\$400)	\$132 (\$400)	\$145 (\$400)
Minimum	\$0 (\$0)	\$0 (\$0)	\$0 (\$0)	\$0 (\$0)

[a] Q1± Q14A
[b] For comparison, values for all respondents, including likely outliers, are shown in parentheses.
[c] The null hypothesis is WTP>0; reject if t≥2.326 (99% confidence).

The overall mean WTP across all species is $20.21. Most respondents, 171 out of 178, provided WTP estimates for all four species. We can pair those responses by species and calculate t values to determine if the differences in responses from one species to another were significantly different from zero. The results are shown in Table 10. (Since the same respondents answered for all four species, these four mean values were not drawn from independent samples, and so a t-test on the difference of means would not be valid.)

Table 10. COMPARISON OF DIFFERENCE IN MEAN VALUES, BY SPECIES, FOR PAIRED RESPONSES

H_O:	$\overline{W}-\overline{D}=0$	$\overline{W}-\overline{SO}=0$	$\overline{W}-\overline{ES}=0$	$\overline{SO}-\overline{D}=0$	$\overline{D}-\overline{ES}=0$	$\overline{SO}-\overline{ES}=0$
t-Statistic: (degrees of freedom=171)	3.529	1.057	2.172	1.601	.070	2.988
Reject; $t \geq 1.645$: (95% confidence)	yes	no	yes	-no (very close)	no	yes

These results indicate that respondents appear to have made some distinction in reporting WTP for different species. The difference in mean values reported for whales and sea otters is not significantly different from zero, but the difference between whales and dolphins or elephant seals is significantly greater than zero. Likewise, the difference between mean WTP for sea otters and elephant seals is significantly greater than zero, and approximately so for the difference between the means of WTP for sea otters and dolphins also. However, the difference between mean WTP for dolphins and elephant seals is not statistically greater than zero.

There might be several reasons for the evidence of some statistically significant differences in WTP between species shown in Table 10. It might be argued that gray whales and sea otters are easier to observe in California and therefore may have more non-consumptive use value. However, blue whales were generally not seen by respondents, yet mean values for them were statistically the same as for gray whales. Also, public exposure to bottlenose dolphins is probably as great, since the wild population lives within a few hundred yards of southern California beaches and the popular dolphin shows at oceanaria also use bottlenose dolphins. Thus, if WTP were attributable largely to "cuteness" and "intelligence," it would seem that bottlenose dolphins would rank at least as highly as sea otters.

One difference which may explain the relatively higher mean valuations for whales and sea otters could be current population status, as described in the species information sheets. Sea otters are a threatened species and are found in California in very small numbers; the same is true for blue whales. This is not true for gray whales, though heightened public awareness about the past endangered condition of the species off California's coast may affect public values regarding this species.

CONCLUSIONS AND CAVEATS: SOME THOUGHTS ON APPLICATION OF CVM RESULTS

Program Benefits: Aggregating Over Affected Households

In Table 9, evidence was provided from the CVM study that the average willingness-to-pay per household in the sample is $23.95, $17.73, $20.75, and $18.29 for protection of the current populations of gray and blue whales, bottlenose dolphins, California sea otters, and northern elephant seals, respectively. Although the payments for whales and sea otters are statistically greater than payments for dolphins and elephant seals, indicating that respondents value these species differently, it might not be true that this implies a total average WTP of $80.72 for all four mammal populations (the sum of the individual averages). Kahneman (1984) has suggested that because of their inexperience in making direct payments for environmental goods, individuals may be drawing upon an "environmental account" in the case of each stated WTP.

Along these lines, we might reason that since the initial instructions to the individual explained that the purpose of the survey was to elicit public valuations for marine mammal protection programs, then some basic amount is budgeted to the "marine mammal protection account" (say, for example, an average amount of $10), and additional amounts represent the respondent's willingness-to-pay for protection of the specific species of mammal discussed. The sum of these marginal benefits from protection of each species would then be the maximum willingness-to-pay for all marine mammals protected.

However, even if this were the case, we do not have information on the proportion of the WTP estimates reflecting the general "marine mammal account." Thus, to avoid over-estimating societal benefits attributable to marine mammal protection programs, we will use only one WTP estimate in aggregating over all California households. Assuming the respondents' average WTP of $23.95/year per household for whales is representative of average California households, and including only households in cities within 100 horizontal miles from the coast (95.14% of the total), we arrive at the following measure of program benefits to Californians:

$$\text{Annual Aggregate Benefits} = \$23.95 \text{ X } (23{,}667{,}902/2.68).9514$$
$$= \$201.23 \text{ Million (1984 dollars).}$$

This estimate of annual program benefits, slightly greater than 200 million dollars, is an aggregate for California households where the 1980 Census of Population for California is divided by 2.68 persons per household. This measure of benefits is for Californians only. It may be that residents of other states also benefit from marine mammal protection, but only a national CVM study would determine the average value of national WTP.

The reliability of this estimate of aggregate benefits in California depends upon first, the existence of bias in the WTP estimates, and second, the extent to which average respondents' values represent average Californians'. With respect to bias, every attempt was made to encourage informed responses by furnishing information about the marine mammals being valued. Furthermore, accepted techniques were utilized for discouraging strategic behavior. To further reduce the effect of strategic and/or hypothetical bias, likely outliers were identified and removed. Evidence is presented that individuals had considered income/commodity trade-offs when starting their maximum WTP values because they did not significantly adjust their bids when given the opportunity to re-evaluate within their income constraint. Also, the individuals' behavior was in accord with theoretical precepts; e.g., the WTP values shown in Table 11 for increments to the marine mammal populations are diminishing, as we would expect for situations of decreasing scarcity.

Table 11. WTP/YEAR PER HOUSEHOLD, OUTLIERS REMOVED.

	Whales (Gray and Blue)	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals
C—>B				
Mean	$ 6.95	$ 4.58	$ 6.12	$ 4.20
Standard Deviation	17.89	12.92	13.83	11.27
B—>A				
Mean	$ 3.70	$ 2.78	$ 3.55	$ 2.57
Standard Deviation	11.86	11.19	11.40	10.09

A problem with mail surveys of this type is the low response rate. While surveys mailed to special interest groups generally attain response rates of 75% or greater, this type of survey must, of necessity, be directed at a random sample of the population. As a result, CVM researchers mailing questionnaires to a random population rarely attain response rates in excess of 35%. This may lead to questions about the representativeness of the responses relative to the average individuals; for example, if only overly concerned individuals returned their questionnaires, then the WTP averages may be upwardly biased. In this study, inspection of the socio-economic characteristics in Table 8 leads us to posit that respondents are in fact, representative of average Californians. This position is further supported by the fact that respondents' avidity for marine recreation and environmental issues was no stronger than avidity rankings provided by Californians in an independent telephone survey.

Appropriate application of CVM results must address the issue of the relevant population over which aggregation is performed. In this estimate, we included most of the population of California since our survey responses were returned from a large spectrum of areas, urban and rural, north and south, and beach and non-beach communities. Most importantly, there was almost no correlation of the stated willingness to pay with the respondents' distance of residence from the coastline. Thus, it seems reasonable to aggregate over 8.4 million of California's 8.8 million households. Furthermore, it may be that residents of other states also benefit from marine mammal protection, but a national CVM survey was not conducted. However, in their whooping crane valuation study, Stoll and Johnson (1984) found that option price/existence value reported by out-of-state non-users was 75% - 100% of the option price/existence value reported by in-state residents.

Valuing Individual Species of Marine Wildlife

In some instances, damages to an individual species may require valuation of one animal population. For example, the California sea otter is listed as a threatened species due to its susceptibility to potential oil spills in the marine environment. Again, based upon Kahneman's (1984) environmental account framework, we might posit that respondents in a CVM survey may be stating some amount which is a base amount for the wildlife category in general. The similarity of stated willingness to pay for each of the four mammal groups lends some support for this hypothesis, though it does appear that some additional amount over and above the "base" is added for particular species of marine wildlife. If, for example, we posit that the base amount is, at most, that stated for the least valued species in the survey, the dolphin, then the additional amount stated as a willingness to pay strictly for protection of the California sea otter is the difference—or $3.02 per household annually (see Table 9). Aggregating over 8.4 million households in California, the annual societal value attached to preservation of the California sea otter is approximately $25.4 million. Again, this estimate does not include values which may exist for non-Californians; in the case of this animal, such values undoubtedly exist for some individuals, as evidenced by a worldwide membership in and contributions to a non-profit organizataion formed to support actions to protect the sea otter.

Valuing Incremental Changes in Marine Wildlife Populations

A difficult valuation task is that of determining societal losses associated with incremental reductions in wildlife populations in the event of a marine pollution incident. Although this study looked at animal population reductions only in the context of reducing the species to historical lows before protection programs were enforced, some evidence of individuals' ability to place values on incremental changes (but improvements) in the marine environment was provided in Table 11.

The WTP responses reported in Table 9 were elicited by a hypothetical situation wherein respondents were asked to estimate their willingness-to-pay to avoid a reduction in the mammal populations below current levels without public protection programs. Respondents were also asked to provide estimates of WTP to obtain incremental increases in the levels of current mammal populations. Given that Situation C is defined as the current population level, Situation B is an increment over the current level (between C and A), and Situation A is a final increment up to the historically high level populationstotheendangeredlevels(asinthevaluesshowninTable9).Also, future research efforts could incorporate questions on willingness to pay to avoid incremental losses in marine wildlife populations.

The Existence of Existence Value

The results in Table 12 have important policy implications. Even when there has been no "use," individuals still explicitly stated that option price/existence value associated with marine mammals is 15.2 times as great as use value for northern elephant seals, 9.8 times as great for blue and gray whales, and 7.4 times as great as use values reported for bottlenose dolphins and sea otters. Pure existence value, without any current or future option to observe the wildlife populations, is 11.6 times as great as use value for the seals, 7.3 times as great for the whales, and 5.5 times as great for the dolphins and sea otters. These results provide evidence that existence values for marine wildlife, where all on-site "use" is precluded, are significantly greater than use values, and they vary for different environmental goods. Even if marine mammals are inaccessible for viewing and impart no regional tourism impacts, societal damages due to marine pollution can still occur. Evidence of the measure of such damages can be found by investigating the existence values which households attach to preservation of marine mammal populations.

Table 12. MEAN WILLINGNESS-TO-PAY RESPONSES:[a]

BREAKDOWNS BY USE AND NON-USE

	Whales (Blue and Gray)	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals
Non-Consumptive Use	$ 2.34 (9.3%)	$ 2.21 (11.9%)	$ 2.49 (12%)	$ 1.16 (6.2%)
Option Price	$ 5.79 (22.9%)	$ 4.15 (22.4%)	$ 4.71 (22.6%)	$ 4.16 (22.1%)
Existence Value	$17.15 (67.9%)	$12.20 (65.9%)	$13.62 (65.4%)	$13.50 (71.7%)

[a]Total WTP, the sum of each column, differs slightly from the values reported in previous tables because a small number of respondents did not break down WTP into these categories. Their valuations were removed from the results shown in this table.

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