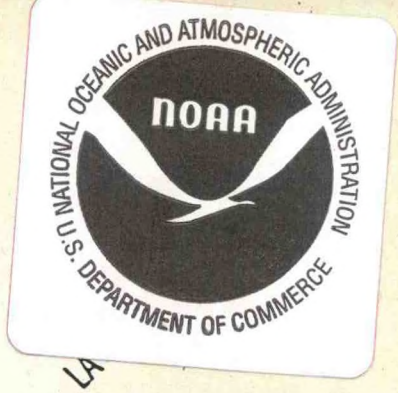

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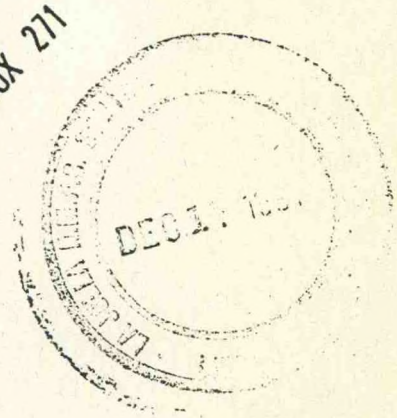

SEPTEMBER 1985

VALUING MARINE MAMMAL POPULATIONS: BENEFIT VALUATIONS IN A MULTI-SPECIES ECOSYSTEM

by

Ronda Hageman

ADMINISTRATIVE REPORT LJ-85-22

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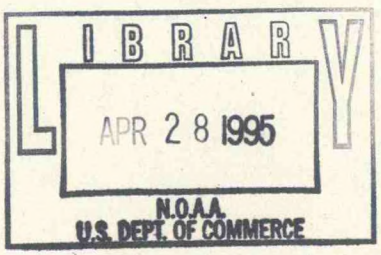

This Report was written while the author was a visiting scientist at National Marine Fisheries Service, Southwest Fisheries Center, La Jolla, California. Dr. Samuel Herrick served as official technical advisor.

Administrative Report No. LJ-85-22

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I. INTRODUCTION

Before the 1960's, over-hunting of a variety of marine mammals had resulted in dangerously low populations of animals and, consequently, isolated pieces of protective legislation.[1] National interest in species preservation sparked passage of the Endangered Species Conservation Act in 1969, which applied to some endangered or threatened marine mammals. However, more sweeping federal legislation was enacted in 1972 with the passage of the Marine Mammal Protection Act (MMPA). Support for some form of marine mammals management/conservation came not only from "protectionist" groups, but also from commercial interests and the scientific community. Because of the diverse interests represented, the Act is an especially broad piece of legislation which has been characterized as "neither purely protectionist nor purely exploitative, but...almost always complex."[2] Adding to the complexity are the mandates of the Fishery Conservation and Management Act of 1976 which apply to the management of several fisheries that interact with marine mammal populations. Consequently, management agencies are faced with the two-pronged problem of marine mammal conservation while managing other interrelated and sometimes competing marine resources. In order to appropriately compare alternative management strategies, more complete information on relevant benefits and costs is required.

Fundamental to the Marine Mammal Protection Act is a moratorium of indefinite length on the taking of marine mammals. The limited exceptions include live capture for public display and a small amount of hunting by native Indians. Also, some taking is allowed if incidental to commercial fishing, though all taking is subject to population stock viability.

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[1]Although a critical inspection of the history of wildlife law reveals that protective legislation was passed only after a species had been decimated to such an extent that the costs of searching/taking rendered it commericially non-viable (e.g., the gray whale, northern elephant seal, and southern sea otter).

[2]Michael J. Bean, The Evolution of National Wildlife Law, (Environmental Defense Fund: Praeger) 1983. p.283.

Lifting of the moratorium can occur if continuing reviews conducted under the Act indicate that the goal of "optimum sustainable population" (OSP) has been attained for a particular marine mammal population. The goal of OSP in the Act is unique to wildlife management in that it recognizes that marine mammals have aesthetic and recreational value as well as commercial value.[3] However, the stated primary concern is maintenance of a healthy marine habitat, so that conservation/management of marine mammals under Section 103(b) requires consideration of all socio-economic factors, including interactive fishery resources.

Marine mammals frequently interact with both commercial and sport fisheries. The animals are sometimes killed, injured, and harassed (both accidentally and deliberately) by fishermen. They impose costs on fishing activities by taking or damaging fish trapped in nets or caught on lines, and by damaging gear during accidental entanglements. A few marine mammals compete with fishermen for fish and shellfish (for example, pinnipeds have detrimentally affected salmon sport fisheries in Oregon and Washington).

Thus, under the Marine Mammal Protection Act, management questions and conflicts can arise in a variety of areas: the possible lifting of the moratorium, the potential for transferring management authority from federal to state agencies, and the requirement to determine OSP within the context of other interacting marine resources but including consideration of non-market values (aesthetics) and non-consumptive uses. A recent workshop sponsored by the Marine Mammals Commission (Contos, 1982) identified areas of research necessary to implement the Act's intent. One of the primary focus areas identified was the need to obtain information about the value of aesthetic and non-consumptive uses of marine mammals as an important input to the design of management/conservation programs. In response to this need, the research effort described in the following chapters is an attempt to develop methodologies aimed at quantifying these values.

Though private citizens, commercial interests, researchers, and managers often hold diverse and divergent views about marine mammal management, all interested parties generally recognize that some benefits and some costs exist. However, both the extent and means of quantifying benefits and costs are frequently unknown, usually based on subjective arguments, and almost always hotly debated.

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[3] Wildlife populations have been managed traditionally according to the principle of "maximum sustained yield," which is based upon stock size relative to commercial take.

Some value categories are relatively easy to estimate. For example, on the cost side, declines in commercial fish takes (e.g., abalone and clams due to protection of sea otters and walruses, respectively) are characterized by observable market prices. In contrast, the valuations for environmental amenities, such as aesthetic benefits attributable to marine mammals, are not explicitly evident because these resources are not sold and priced in markets. A dearth of attempts have been aimed in the past at valuing aesthetics associated with animal species in general, and virtually none aimed specifically at marine mammals. However, a variety of economic studies have attempted to value the aesthetic benefits of recreation and environmental quality. In the following section, the theoretical basis is outlined for utilizing one technique known as the contingent valuation method. In order to investigate the potential for bias when this technique is used, a number of findings from several recent recreation/environmental quality studies are discussed.

A discussion of issues which arise in the valuation of aesthetic and consumptive/non-consumptive uses of animal species is presented in Section III. A few recent efforts have been made to address some of these issues for terrestrial species, and a review of these studies is presented. However, the majority of these studies rely upon consumptive uses of animal species; i.e., hunting and fishing values. In order to extend further the application of non-market valuation techniques to animal species, this study as outlined in Sections IV and V represents an attempt to determine the benefits of marine mammals that currently have no consumptive use.

In Section IV, a description is presented of a contingent valuation survey mailed to a randomly selected sample population in California. Mailed from San Diego State University in July of 1984, the intent of the survey was to:

(1) elicit household responses to willingness-to-pay types of questions regarding preservation of marine mammal populations off California's coast;

(2) determine if valuations can be provided for incremental increases, or to avoid incremental decreases, in current marine mammal populations;

(3) provide information on how several different species of marine mammals are valued, and whether or not population characteristics (e.g., "threatened" status or accessibility for viewing by humans) affect valuations;

(4) collect observer data on marine mammal viewing off California's coast and determine whether or not travel cost information can be used as an alternative method for valuing aesthetics and non-consumptive uses associated with marine mammals.

An analysis of the results of the survey is presented in Section V. Section VI concludes with caveats and recommendations for future research.

II. METHODOLOGICAL ISSUES

In an era of heightened demand for fiscal accountability, public resource managers are under increased pressure to justify policy decisions and management plans. In the area of marine resource management, an important aspect of program decisions is frequently the variety of aesthetic/recreation benefits of the marine ecosystem. As noted previously, the Marine Mammals Protection Act specifically requires consideration of such non-market benefits.

Economists have developed a framework for describing the valuation of non-market benefits. In Figure 1, the Total Value Framework (Randall and Stoll, 1983) illustrates how financial (market) values frequently can under-estimate the total economic value of a resource. Use values include off-site and on-site use, both in the present and in the future. On-site use may be consumptive (e.g., sport fishing and hunting) or non-consumptive (e.g. birdwatching and aesthetic appreciation of natural environments). For this reason, financial aspects of marine resource use, such as commercial fish sales and offshore oil development, represent a part, but not all, of the total value of the marine environment. Off-site use value includes the experiences which people value such as television and magazine documentaries. Furthermore, it has been argued that in the case of publicly owned goods where there is potential for irreversible decisions, individuals may also attach value to preserving the option for future use. Lastly, it may also be the case that even without the possibility of personal use (neither consumptive nor non-consumptive), some individuals may attach value to simply knowing a particular resource exists as a part of the ecosystem.

Many resource management issues revolve around marketed resources (coal, timber, commercial fishing). The total value of these resources is frequently the financial value reflected by market prices in competitive markets. However, the use of market prices to estimate the value of many environmental goods and services ignores a variety of non-market values. For example, attempting to value a whale population by using the market price of whale oil and whale meat in Japan ignores all of the non-consumptive values which many people have for whales. Evidence that some value exists above market value is demonstrated by many observable behaviors - the high demand for whale watching tours, the public's demand for protective legislation, and the demonstrations against whale hunting by protectionist organizations. Since these activities have both monetary and time costs, it must be true that the expected benefits from marine mammal protection programs are at least as great as those costs.

Even so, listing the ways in which people express their non-consumptive values allows only subjective arguments about changes in environmental quality. In recent years, economists have explored ways to discover "implicit prices," i.e., those implied by people's behavior, in order to quantify individuals' non-market values. As with market goods, it is reasonable to assume that individual values can be expressed as a willingness-to-pay for changes in environmental quality, wherein the individual takes into account any relevant trade-offs involved (e.g., foregone time and/or consumption of other goods). Thus, the values that individuals place on such changes constitute an appropriate measure of economic benefits. Aggregate benefits can be determined by summing over

the relevant population.

The basic framework for analysis is consumer demand theory. Generally, environmental quality changes affect individuals in three possible ways:

(1) price changes of goods purchased in established markets;

(2) price changes of factor inputs owned by individuals; and

(3) quantity changes in non-market commodities.

In the case of wildlife protection, the proposed changes will likely be transmitted through the first and third routes.

The benefits that result from these changes can be described through the use of consumer welfare theory. The starting point for such an analysis is the individual demand curve for an affected commodity. The demand curve relating price to quantity purchased, all else constant, is shown in Figure 2. This curve shows the maximum amount the individual is willing to pay for each quantity of the good. The downward slope of the curve indicates that more is demanded at lower prices than at higher prices. The diagram indicates that at price P_1, the individual will purchase Q_1 and have total expenditures equal to the area OP_1BQ_1. However, the total amount that the individual is <u>willing</u> to pay for the quantity Q_1 is OP_1BQ_1 (total expenditures) <u>plus</u> the triangular area P_1AB. The difference between total willingness to pay and the amount actually paid is defined as consumer surplus--the dollar value of the satisfaction the individual derives from the consumption of the good, exclusive of payments made.

Changes in consumer surplus yield information on the value of specific changes from the initial state. Consider the case in which the price falls from P_1 to P_2. This yields an increase in consumer surplus of P_1BCP_2, suggesting that the individual's welfare has increased. The same measure of welfare change can be used when the quantity changes from Q_1 to Q_2. Therefore, estimates of consumer surplus changes can be utilized to describe the impact of environmental quality changes. However, ordinary consumer surplus cannot be defined in terms of the underlying preference patterns of the individual. This is because the individual's level of satisfaction is allowed to vary along the demand curve. An ideal measure of benefits would keep the individual's satisfaction level constant along the demand curve.

In his seminal work on consumer demand theory, Hicks (1943) suggested some alternative measures of benefits. The two Hicksian variation measures of welfare change are:

- Compensating Variation - the amount of compensation, paid or received, that would keep the individual at his/her initial welfare level if the change does occur.

- Equivalent Variation - the amount of compensation, paid or received, that would bring the individual to his/her subsequent welfare level in the absence of the change.

The essential differences between the Hicksian variation measures and ordinary consumer surplus for a price decrease can be determined by examining Figure 3 in which the two Hicksian demand curves correspond to the initial welfare level (H_I) and the subsequent welfare level (H_S). As established previously, the change in consumer surplus equals the area X + Y. The compensating variation measure of the price change equals area X. This uses the original welfare level as the reference point and specifies the amount of compensation that must be subtracted in order to keep the individual's welfare level constant, given the price decrease. The equivalent variation measure equals the areas X + Y + Z and corresponds to the amount of compensation the individual must receive to forego the price decrease. As is evident, for a price decrease the equivalent measure exceeds, in order, consumer surplus and compensating variation. The difference between these measures hinges upon the operation of the income effect associated with the implied property rights. That is, compensating variation corresponds to the maximum the individual is willing to pay (WTP) to obtain the price decrease. This measure is bounded by available income, since the underlying presumption is that the individual must pay to obtain the improvement in welfare. On the other hand, equivalent variation for a price decrease corresponds to the minimum the individual must be paid--or is willing to accept (WTA)--to forego the opportunity of the price decrease. This measure is unbounded by income, because the individual is presumed to have the property rights initially. Thus, WTA can be expected to exceed WTP except in cases where the income effect is negligible. In these latter cases, equality is expected. It should also be noted that consumer surplus is not equal to either variation measure. However, it has been argued (Willig, 1976) that the differences are likely quite small for most commodities.

These variation measures of welfare change allow the individual full adjustment of purchases in response to changes in price. The following Hicksian surplus measures restrict the individual's adjustment process.

- Compensating surplus is the amount of compensation, paid or received, that would keep the individual at his/her initial welfare level, given the change that occurs and holding the consumption of the good whose price changes at its subsequent level.

- Equivalent surplus is the amount of compensation, paid or received, that would bring the individual to the subsequent welfare level in the absence of the change, holding consumption of the good whose price changes to the initial level.

The Hicksian surplus measures were originally defined as measures of welfare change resulting from price change, given that the quantity adjustment of the good whose price changed is restricted. However, it is possible also to interpret the surplus concepts as measures of welfare change associated with a quantity change (Randall and Stoll, 1974). Therefore, these concepts have use in cases in which the quantity of a non-market good, rather than price, changes. Similar to the variation measures, equivalent surplus exceeds compensating surplus for an improvement due to the operation of the income effect.

Therefore, the objective of benefit estimation is to determine the appropriate Hicksian measure of the welfare change associated with the proposed environmental changes. Or, in situations in which consumer surplus does not deviate greatly from the Hicksian measures, then the former can be utilized as a reasonable estimate.[4] In either case, benefit estimation is a relatively straightforward exercise in situations in which market data exist. After obtaining data on the demand curve, price and quantity adjustments associated with the environmental changes yield the benefit estimates. However, there are a variety of situations in which market data do not exist. For instance, the aesthetic quality of a recreation visit is a non-market good. As such, there exist no price/quantity data from which benefits can be estimated. In those cases, alternative benefit estimation methods must be utilized.

There are two general approaches for determining values that individuals place on changes in non-market commodities. The first approach is to ask individuals directly via survey instruments. This method is referred to as the contingent valuation method (CVM), because individuals are asked to determine values based upon a set of contingent conditions. A second approach is to analyze data from market transactions in goods and services related to the non-market good. Therefore, in lieu of market data on the directly affected good, the analyst investigates market goods related to the affected environmental quality good. For instance, the travel cost method utilizes travel expenditures to determine the consumer surplus value of a recreation experience.

A. The Contingent Valuation Method

1. Overview

The contingent valuation method involves a process whereby individuals--study respondents--are asked directly to place values on specific environmental changes within the context of a contingent market. This represents an attempt to determine the relevant Hicksian welfare measure through direct means.

The CVM can be viewed as an attempt to simulate conditions found at an auction. After the commodity is described to the study respondent, he/she asked to offer a bid for it. This bid represents his/her maximum willingness to pay (WTP) or minimum willingness to accept (WTA) for that commodity. In some cases, an auction-like bidding process takes place as part of the CVM.

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[4]See Willig (1976) and Randall and Stoll (1974) for a detailed description of the relationship between consumer surplus and the Hicksian measures.

Interest in the CVM as a means for valuing environmental commodities arises from the nature of such commodities. That is, actual markets do not exist for these goods and, therefore, direct market values that reflect social values do not exist. The essence of the CVM is that it simulates market conditions, thereby deriving measures that are akin to those observed in actual markets.

Davis (1963) pioneered the use of the contingent valuation method in an analysis of demand for outdoor recreation. Respondents were asked how their use of an area would be affected as the costs of its use were increased. Costs were increased until exclusion was induced. Individual responses were then aggregated to generate a demand curve for recreation activity in the area. Knowledge of the demand curve then yielded benefit estimates. The primary long-lasting contribution of Davis was the interative bidding format. It remains the dominant method of obtaining a reasonable response to value questions.

Publication of the Randall, Ives and Eastman article (1974) popularized the CVM as a method for determining the value of non-market goods. This popularity has resulted in a number of subsequent studies. These efforts have been summarized in Schulze, d'Arge and Brookshire (1981); Mitchell and Carson (1981); and a recent work by Cummings, Brookshire and Schulze (1984). The methodology has been used to value a wide range of non-market commodities--from air quality to wildlife.

2. Basic Themes in CVM Literature

Three general themes appear repeatedly in the literature just cited. The first is a general consensus on the procedures for successful application of the CVM. These were initially stated by Bohm (1972) and later reemphasized by various authors. The basic procedures are:

- o The services of the non-market good are described clearly to the respondent.
- o The alternative situations (service level) are described in detail using, where necessary, props like photographs, maps, etc. The detail is necessary to ensure uniform perception.
- o All situations are presented in the most realistic and credible manner possible, and there must be little uncertainty.
- o The respondent is placed in a simulated market and asked to make a marketlike decision.[5]
- o The payment vehicle must be routine, focus on the relevant attitudes, and encourage revelation of preferences.

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[5]Note that a market decision is quantity given price, whereas the CVM usually describes situations in which the respondent is to determine price given quantity.

The second major theme is that the results of previous studies seem generally reasonable and indicate that the CVM performs at least as well as other valuation methods. Brookshire and Crocker (1981) demonstrate that the CVM possesses a number of advantages in the conduct of benefit-cost analysis. Among these are that the CVM data accord more closely with the conditions of received economic theory and that estimation and interpretation problems introduced by confounding variables are reduced. In addition, Schulze, d'Arge and Brookshire (1981) demonstrate that the CVM is consistent with economic theory, that the results are replicable, and that it requires fewer a priori assumptions than other valuation methods. Further, Schulze, Cummings, et al. (1983) find the CVM consistent with a broad range of testable hypotheses that stem from economic theory. Hoehn and Randall (1983) demonstrate that even if there are errors in the CVM, they are predictable in direction so that the CVM is a satisfactory benefit-cost estimator.[6] Finally, a number of studies have found the CVM consistent with other valuation measures, thereby providing additional support for the validity of the CVM results. Among these are Brookshire, Thayer, Schulze and d'Arge (1982); Cummings, Schulze and Meyer (1978); and Desvousges, Smith and McGivney (1982). In these papers, comparisons are made with the travel cost method and other market-based estimation procedures known as the hedonic housing approach and hedonic wage analysis.

Although substantial evidence points to the reasonableness of the contingent valuation method, evidence exists that the methodology may be beset with a variety of biases. Thus, the third major theme of the previous literature is the discussion of possible biases that may render the results of the CVM uninterpretable. The major suspected biases can be grouped into three categories according to the facet of the survey that is affected:

- o the incentive structure;
- o the information structure; and
- o the implementation.

3. Potential Biases

a. Biases Relating to Incentive Structure

Consider first the incentive structure of the survey. Since

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[6] An optimal benefit-cost estimator would accept all worthwhile projects and eliminate all projects with negative net present value. Hoehn and Randall (1983) demonstrate that the CVM eliminates all projects with negative net present value but may also eliminate some with positive net present value. Thus, it is satisfactory but not optimal.

individuals are being asked to determine the maximum they would be willing to pay[7] for some non-market good, some individuals may have incentives to conceal their true preferences. For instance, if an individual is fully liable for his/her bid, then understatement of the true willingness to pay can be expected. On the other hand, zero bid liability would likely result in an overstatement. Each of these cases represents a form of strategic behavior in which the respondent acts purposefully to affect the results in his/her favor. In the first case, the individual maximizes the chance that the non-market good is provided and, again, escapes payment. Obviously, if strategic behavior is commonplace, then the CVM results will be invalidated. Since Samuelson's seminal article (1954), it has been widely believed that strategic behavior would prevent direct revelation of consumers' preferences. It was expected that individuals would behave strategically in survey situations as they do in other economic circumstances. These other situations include the overuse of commonly held goods. There is substantial literature documenting this phenomenon, the results of such behavior, and efforts to prevent it (see Hardin and Baden, 1977, for a group of readings on the subject).

A number of studies have examined the existence of strategic behavior in contingent situations. For instance, Bohm (1972) employed five different liability rules in an experimental situation to estimate the value of a non-market good. Four of the five approaches were designed to provide incentives for respondents to behave strategically. However, the main result of the experiment was that none of the five approaches gave an average value that was significantly different from the other approaches. Further, Brookshire, Ives and Schulze (1976) developed a simple test, dependent on the dispersion of the individual bids, to detect the existence of strategic behavior. They found none. Randall, Ives and Eastman (1974) and Rowe, d'Arge and Brookshire (1980) also found negligible evidence of strategic behavior. In addition, a number of studies have examined strategic behavior under laboratory conditions. These include Marwell and Ames (1981), Grether and Plott (1979), and Vernon Smith (1977). The general conclusion is that strategic behavior is not prevalent. Only in Cronin (1982) was strategic behavior discovered.

The conclusions concerning strategic behavior are that:

(1) there is limited evidence of its existence in contingent situations; and

(2) it can be detected through either the use of a test as in Brookshire, Ives and Schulze (1976) or an outlier identification test as Belsley, Kuh and Welsch (1980) suggest.

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[7] an alternative approach is to ask the respondent to determine the minimum willingness to accept. However, as will be demonstrated in the following sections, this approach has implementation difficulties.

Although strategic behavior is a common concern among economists, its importance has probably been overstated in survey situations. There are two likely reasons for this. First, individuals tend to behave truthfully until there is evidence that others are not (Hoehn and Randall, 1983).[8] Second, these survey and experimental situations are usually hypothetical, lacking in consequence realism; thus there is no reason to behave strategically. This implies that hypothetical situations are, in effect, a solution to strategic behavior. As an additional safeguard against strategic behavior, the survey can employ an incentive-free payment mechanism (see McMillan 1979, for a survey). As an example, Randall, Ives and Eastman (1974) suggest the use of a payment scheme in which the individual's liability is the average response of all individuals. While not completely incentive-free, the average payment scheme increases the difficulty of implementing a successful strategic bid, since knowledge of the sample mean and sample size is required.

With regard to the incentive structure of the survey, strategic behavior seems a surmountable problem. However, one of the solutions, the use of hypothetical situations, produces another problem—that of accuracy or hypothetical bias. The argument is that if the situation lacks consequence realism, then there is no reason to perform the mental gymnastics required to give an accurate response. The effect of this bias could be to leave the mean of the responses unaffected but increase the variation in the bids. Or, since the bids are bounded from below by zero, the increased variation could cause an upward shift in the mean response as well. Again, the validity of the results is subject to question if this bias exists.

One method has been used to test for the existence of hypothetical bias in the CVM. This is to validate the CVM results through a comparison with another valuation method. This is the approach utilized by Bohm (1972) and Bishop and Heberlein (1979). In the former study, Bohm found that the hypothetical situation yielded a mean response significantly higher than any other approach. In a study of goose hunting permits, Bishop and Heberlein found that the hypothetical markets were significantly biased when compared to a simulated market in which actual monetary payments were made. The results of their study were that hypothetical willingness to accept was approximately 60% less than actual willingness to accept. Thus, hypothetical bias was manifested in two ways. First, there was a large deviation between actual and hypothetical values. Second, the discrepancy between willingness to accept and willingness to pay was too large to be explained by any income effect. This latter result was found also in the work of Gordon and Knetsch (1979) and Knetsch and Sinden (1984).

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[8]this implies that individuals act strategically because everyone else is doing it, rather than as an attempt to take intial advantage of the situation.

These issues can be handled separately. First, consider the evidence relating actual values to the hypothetical values. Mitchell and Carson (1981) question the Bohm (1972) results based on a reinterpretation of the statistical evidence. Mitchell and Carson argue that the group subject to the hypothetical situation had a significantly larger income, and this may account for its greater willingness-to-pay bid. In addition, they point out that if one outlier from this group were removed, then there would be no significant difference between this group and the other groups. In a later paper, Carson and Mitchell (1983) question the Bishop and Heberlein results. Again, Carson and Mitchell use a reexamination of the statistical evidence. In this case, they alter some of the assumptions that Bishop and Heberlein made. Their conclusion is that under slightly different assumptions, the Bishop-Heberlein conclusions are reversed; that is, the disparity between actual and hypothetical values is no longer significant. Therefore, the Bohm and Bishop-Heberlein conclusion that hypothetical questions yield biased answers may possibly be overstated.

The large disparity between WTP and WTA remains a question to be examined. Hovis, Coursey and Schulze (1983) conducted an experiment in which each of these measures was compared to the actual value derived from a Vickrey second-price auction. Their findings support the wide disparity between WTA and WTP. However, they also found that WTA is the biased measure, whereas WTP is not significantly different from the actual auction-determined value. They conclude that the WTA measure is unacceptable since individuals have limited experience with this compensation form. Therefore, WTA does not meet the rules for successful application of the CVM because it is not realistic and credible.

The conclusions regarding the existence of hypothetical bias are:

(1) evidence of its existence is questionable upon reexamination of the statistics utilized; and

(2) WTP outperforms WTA as a valid measure of value.

Further, supporting evidence for these conclusions is found in the comparative analyses of Cummings, Schulze and Meyer (1978), Thayer (1981), Brookshire, Thayer et al. (1982), Desvousages, Smith et al. (1982), and Sellar et al. (1984). In each of these studies, hypothetical WTP was compared to alternative valuation measures (hedonic housing analysis, hedonic wage analysis, travel cost, and modified travel cost). No evidence of hypothetical bias was discovered. Also, Aizen and Fishbein (1977) have shown that the more closely a hypothetical experiment corresponds with actual situations, the less likely will be hypothetical bias. Again, attention to the rules for successful application of the CVM helps to minimize potential problems.

Both strategic and hypothetical biases are related to the incentive structure of the CVM. Neither seems to be an important deterrent to the use of the CVM. There is little evidence of strategic behavior in contingent situations. Further, it can be detected through the use of simple tests. Hypothetical bias is also seldom seen. However, for the purpose of providing additional validation for the CVM results, it is useful to use another valuation method, such as the travel cost technique, whenever possible. This presumes of course that travel is a prerequisite

of obtaining benefits from the good to be values.

b. Biases Relating to Information Structure

The second major category of biases is related to the information structure of the survey; the information provided to the respondent may bias the ultimate values obtained. Included in this category are starting point bias, payment vehicle bias, and information bias.

Starting point bias occurs when the individual's bid is influenced by the point at which the bidding procedure begins. The bidding procedure usually employed requires the respondent to answer yes or no to a series of bids that represent the individual's willingness to pay. Conducted similar to an auction, the maximum willingness to pay is determined through the use of an interative process. However, it is possible that the final bid may be sensitive to the starting point.

The evidence concerning starting point bias is inconclusive. Studies by Brookshire and Randall (1978), Thayer (1981), Randall et al. (1978), and Greenley et al. (1982) tested for starting point bias and found no evidence. However, Rowe, d'Arge and Brookshire (1980) found strong evidence that the willingness to pay was affected by starting point. Also, Mitchell and Carson (1982) provide a reinterpretation of Greenley et al. (1982) to show evidence of starting point bias, and recent studies by Thompson and Roberts (1983) and Boyle et al. (1984) found that starting point had a strong effect on CVM results. Thus, it has been suggested that an alternative to avoid starting point bias is to use a payment card where individuals are asked to choose their own starting point (see Mitchell and Carson, 1981). Iteration can then begin from that point. Kahneman (1984) states that individuals unfamiliar with valuing a particular commodity will still exhibit starting point bias by using the middle range of the payment card; however, evidence provided in Desvousages et al. (1983) does not support this contention.

Another bias related to the information structure of the questionnaire is payment vehicle bias. This bias occurs when the respondent is influenced by the method of payment for the CVM study. A number of different payment schemes are available; user fees, utility bill increases, and increased consumer prices or taxes. To be effective, a payment vehicle must be familiar to respondents, require routine behavior, focus on the relevant situation, and encourage individuals to reveal their preferences. The literature on payment vehicle bias indicates that it exists in certain situations, especially those that utilize taxation as the payment scheme. Both Rowe, d'Arge and Brookshire (1980) and Greenley, Walsh and Young (1981) found evidence of its existence. In each case, the tax payment vehicle resulted in substantially lower average willingness-to-pay figures. The message, then, is to avoid taxation vehicles.

The third bias related to the information structure of the survey is the general category of information bias. This bias is attributable to the amount and types of information given to the respondent. In experimental situations, Grether and Plott (1979) and Kahneman and Tversky (1980) found that the manner in which questions were framed has a marked impact on respondent behavior. Furthermore, the nature of willingness-to-pay responses to the information given is not well understood. For example,

aggregation of bids for various environmental quality benefits may present a problem. Kahneman (1984) has argued that individuals may provide an "environmental account" bid as opposed to being able to break that account down into various aspects of their environment, such as separate and additive bids for air quality, water quality, animal species, etc.

In contingent valuation studies, the available evidence (admittedly limited) has found little support for information bias. Thayer (1981) and the summary papers of Schulze, d'Arge and Brookshire (1981) and Mitchell and Carson (1981) concur with this conclusion. Attention to the requirements of sound questionnaire design should help to eliminate the effects of this bias. However, the problem of respondents' lack of familiarity with translating environmental quality information into stated values remains an area in which further research must be conducted to improve the means of eliciting willingness to pay estimates.

c. Biases Related to Survey Implementation

The final category of biases relates to the actual implementation of the survey. Included in this category are biases due to sampling errors or interviewer variation. The first of these can be eliminated through precise sampling procedures. The latter problem, bias induced by variation in interviewer characteristics, is potentially more important. There have been two explicit tests for this bias. In neither Cronin (1982) nor Desvousges et al. (1982) was interviewer bias demonstrated conclusively. Further, it can be minimized with training sessions and the use of experienced professional interviewers. When mail surveys are used, Dillman (1978) suggests ways that researchers can phrase questions so as to avoid prompting responses.

A final consideration, which is consistent with most of the biases outlined above, is the presence of protest bids. These occur because respondents refuse to participate in the contingent valuation experiment and vote their disapproval through the bid mechanism. This may be related to the hypothetical nature of the experiment, the starting point, the type of payment vehicle, etc. Whatever the reason, individuals who protest the survey situation must be identified and eliminated from further consideration. Desvousges, Smith, and McGivney (1982) proposed a protest bid test wherein protestors were identified through additional questions about the reason(s) for their bid. After identification of these individuals they were eliminated. Unfortunately, though these individuals may have positive valuations, there is not a reliable technique at this time to include them in the CVM results.

4. Summary

In conclusion, the CVM has been generally well received. The rules for successful application have been established. It has been demonstrated that the CVM is consistent with economic theory and produces replicable results. However, there are a variety of possible biases that must be countered. In general, evidence of their existence is limited and, when detected, the biases can often be corrected through sound questionnaire and sampling design.

B. The Travel Cost Method

If the environmental quality change has recreation implications, an alternative means of measuring benefits for purposes of comparison with the CVM results is use of the travel cost method.[9] This is the approach employed by Desvousges et al. (1983). Thayer (1981) used a modified version of the travel cost method to test for hypothetical bias. Recent examples of applications to public goods include Maler and Wyzgar (1976), Huppert and Thomson (1984) and Miller and Hay (1984).

1. Theoretical Basis

The basic operational assumption of the travel cost method is weak complementarity (Maler, 1974; Freeman, 1979). In this context, weak complementarity implies that an individual's willingness to pay for environmental improvements at a particular recreation site is zero unless the site is used. In other words, the benefits to a particular individual of environmental quality changes are zero unless the resource is used by that individual. It should be noted that this restriction implicitly excludes option, existence, and bequest values (non-use benefits).[10] Where these latter values exist, then the travel cost method provides only a lower bound estimate of the value of the environmental changes.

The assumption of weak complementarity can be useful in determining the benefits of environmental changes at a recreation site in the following manner. Weak complementarity implies:

- at some price, the demand for recreation at the specific site goes to zero; and
- a change in environmental quality does not affect the individual's utility if the resource is unused.

An individual is assumed to be in equilibrium at point A in Figure 4. At this point, the individual pays price (entrance fee) P_1, for each visit, V_1. If environmental quality is improved, then the individual's demand curve will shift to D_2. The individual then achieves a new equilibrium at point B along demand curve D_2. The appropriate measure of benefits is the area ABCE between the demand curves. Theoretically, this area is determined through a three-step procedure. The first step is to postulate a hypothetical price increase to P_2, at which the demand falls to zero. This causes a loss in consumer surplus of area P_1EA. The second step is

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[9] For literature reviews see Dwyer, Kelly, and Bowes (1977) and Freeman (1979).

[10] See Section III for a detailed discussion of these values and their applicability in this research.

to postulate the environmental improvement. This shifts the demand curve to D_2 but does not affect the individual since demand is zero (weak complementarity). The final step is to postulate a hypothetical price to the original P_1, which causes a change in consumer surplus equal to area P_1CB. Benefits are then the difference between the beginning and ending positions (area ABCE). In order to estimate this area, one needs knowledge of the shape of the demand curve and the magnitude of the shift in demand caused by the change in environmental quality.

2. Rationale for the Travel Cost Approach

The individual's demand curve for a particular recreation site is a function of a number of variables. Among these are price (entrance fee), prices of other goods, distance to the site, travel cost, travel time, time cost, income, and environmental quality parameters. Of course, the demand curves in Figure 4 are drawn as two-dimensional relationships between price and quantity (visits), all else constant. Thus, all other variables serve as demand shifters in the price/quantity space. Therefore, the two most important problems are to determine: (1) the price/quantity relationship; and (2) the magnitude of the demand shift caused by the environmental change.

Demand estimation would be straightforward if the normal practice were to charge an entrance fee and if the fee varied.— However, the typical practice for publicly provided recreation sites is to charge either a zero price or a nominal entry fee. In addition, fees for a particular site rarely vary. Without price variation, it is not possible to estimate the demand curve using normal econometric practices. In lieu of direct demand estimation, it is possible to infer how a given group of people would respond to price changes in the entrance fee by examining data on their response to travel cost differences. This is the basic hypothesis of the travel cost method of demand estimation.

The simplest version of the travel cost method is outlined by Freeman (1979) and includes the following steps:

- For a given recreation site, the surrounding area is divided into concentric circular zones for the purpose of measuring the travel cost from each zone to the site and return.

- Visitors at the site are sampled to determine their zones of origin. This allows for estimation of the existing demand curve. However, since the environmental change shifts the demand curve to the right, some present non-users may be induced to use the resource. This may require sampling of the non-user population.

- Visitation rates defined as visitor days per capita are calculated for each zone of origin.

- A travel cost measure is constructed to indicate the cost of travel from the origin zone to the recreation site and return. These costs include both explicit (auto, lodging, etc.) and implicit (time) costs.

- Visitation rates are regressed on travel costs and socio-economic variables such as average income, median educational attainment, and the like. The regression tests the hypothesis that visitation rates depend in part on travel cost.

- The observed total visitation for the site from all travel cost zones represents one point on the demand curve for that site--that is, the intersection of the present horizontal price line (either at zero price or the typical nominal entry fee) with the true economic demand curve.

- Other points on the demand curve are found by assuming that visitors will respond to a $1 increase in admission price in the same way that they would to a $1 increase in computed travel cost.

  To find the point on the demand curve for the site when the admission price rises by $1, the estimated visitation-rate equation is used to compute visitation rates and total visits for all travel cost zones with the existing travel cost plus $1. Visits are summed across travel cost zones to determine the predicted total visitation at the higher price. These calculations are repeated for higher and higher hypothetical admission prices and the full demand curve is traced out (Freeman 1979).

This method can be based on the pooling of data by travel cost zones or on individual observations.

There are several issues which require special attention when utilizing the travel cost method to estimate the demand curve for a recreation site or activity. These include the opportunity cost of time spent (Cesario 1976; McConnell and Strand 1981); the confounding influence of nearby alternative sites (Cichetti et al. 1976; Ravenscraft and Dwyer, 1978; Morey 1981); and the degree of congestion at the study area (Freeman 1979). However, the general applicability of the travel cost method hinges upon the assumption that on-site recreation use is an important part of individuals' value framework. If this is not the case for a population of marine mammals, where accessibility for observation may be relatively limited for the general populace, the travel cost method may be inapplicable.

C. Preservation Benefits

Non-use valuations have been called preservation values or benefits (Walsh et al., 1984). Preservation benefits have been categorized as having three basic forms; option value, existence value, and bequest value.

Option value can be defined as the amount an individual would be willing to pay to ensure the option of using an environmental resource at some point in the future. It is the difference between the option price (the maximum amount a consumer would be willing to pay for a certain claim on the future use, including the use value) and the expected consumer surplus associated with the use of the resource.

Considerable controversy has surrounded the likely sign and size of option value depending upon the conditions of uncertainty in demand and/or supply. Mendelsohn (1984) provides a comprehensive review of the issues which will not be reiterated here. He presents convincing arguments in support of Freeman (1984) that the size of option value is small enough that it can be safely ignored when a high degree of uncertainty exists. Bequest value is essentially intergenerational option value and can be treated as such.

Existence value, however, is not linked to use of the environmental resource, and hence can be viewed as distinct from option and bequest values. Existence value was first discussed by Krutilla (1967) as the willingness to pay for preservation even when there is no expectation by the individual to use the resource now or in the future. Some attempts have been made to elicit existence values using the CVM, but Mendelsohn (1984) points out that the majority of these studies did not make clear to respondents the notion that absolutely no use of the resource would be allowed. However, in the water quality study by Desvousges et al. (1983), the non-use aspect of the existence valuation was made quite explicit, and willingness-to-pay responses still differed significantly from zero.

In summary, where valuation of non-market goods is useful for making public policy decisions about environmental quality, consideration of the total value framework is necessary. Two techniques which have been employed are the contingent valuation method and the travel cost method, though most applications to date have focused upon use values (primarily those of recreation users). However, the values individuals have with respect to marine mammal populations may not always be captured by estimates of willingness-to-pay for recreation (i.e., viewing the animals) so that some consideration of preservation values may be warranted. In this regard, attention will be focused in the following section upon issues associated with the application of the CVM to valuing animal populations.

III. VALUING MARINE MAMMAL POPULATIONS

A. Purpose of Valuation

Though the contingent valuation method was first used only 20 years ago, the technique has been applied in a large number of environmental quality and recreational settings. In the context of public policy, benefits estimation of public programs has taken on greater importance in the current era of fiscal responsibility; thus, use of the CVM has received greater attention and acceptability. For example, measurement of recreational/aesthetic benefits is required by the Water Resources Council (unit day values) and the U.S. Forest Service's Resource Planning Act (values for wildlife and fish) (Loomis et al. 1984). The Resources Planning Act, National Forest Management Act, and the Bureau of Land Management's Rangeland Investment Policy Act all explicitly require resource valuation in terms of net economic surplus. And, under the Marine Mammals Protection Act [Section 2(6)] , marine mammals are "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 extent feasible commensurate with sound policies of resource management" (emphasis ours). Under Section 103(b), all socio-economic factors must be considered, including "utilization of fishery

resources."

A question which might be raised is, "Why marine mammals?" as opposed to terrestrial mammals or other animal species. One reason for the organization of protectionist groups favoring sweeping conservation measures for marine mammal populations was that upper order mammals, with larger brains and features which lend to anthropomorphizing, are generally perceived as being more intelligent and nearer to humans than lower order species. However, the relative ease with which broad protective measures were passed under the MMPA is perhaps better explained by economic reasons.

Many marine mammals do not exhibit territorial behavior, as do most upper order terrestial mammals. For this reason, marine mammals have not been as detrimental to human commercial operations as terrestial predators (for example, mountain lions preying on ranch animals). Further, marine mammals frequently have been able to adapt to ocean transport activities and settlement along coastlines, whereas large territorial predators on land (wolves, grizzlies) could not adapt to human encroachment. However, many marine mammal populations have increased, expanding both their range and numbers, under nearly total protection. As a result, more economic conflicts have begun to arise.

Both commercial and sport fishing operations have begun to suffer economic losses. Economic loss occurs when the animals take fish caught in nets or become entangled in nets and damage gear. One recent study calculated the annual (1980) dollar loss as $600,000 (DeMaster 19??) in commercial California fisheries alone due to marine mammal (primarily pinniped) interactions. This estimate does not include losses in the shellfish industry attributed to expansion of the southern sea otter's range.

Other interactions, insignificant as yet, may occur as coastal development proceeds. Offshore oil drilling and transport activities can be expected to lead to potential impacts on marine mammal populations, especially in the event of an oil spill. Continued growth in both human and marine mammal populations will undoubtedly lead to conflicts involving recreational uses of beaches, coastal pollution, ocean transport routes, growth of aquaculture, etc. Thus, the economic costs of protecting marine mammals may be expected to increase, not only due to increased conflicts in the use of other marine resources, but also due to agency requirements for research/enforcement activities under the MMPA.

As a result, conservation/management of marine mammals can be enhanced by information not only on economic costs, but also on economic benefits. The majority of costs associated with marine mammal conservation can be measured directly using market values (with the exception of foregone recreational opportunities). On the other hand, benefits frequently will be non-market values, such as the values attached to recreational and aesthetic benefits due to long run impacts of marine mammals' contribution to the food chain. For example, positive near shore impacts due to the predation of sea otters on shellfish have been identified in northern

California. Reduction of shellfish, which feed upon kelp, results in greater kelp production and growth of finfish stocks. The increase in both kelp and finfish can be evaluated using market data on commercial kelp and fish prices.

With the exception of a similar relationship in Alaska between walrus and shellfish, this type of market benefit due to the presence of marine mammals is not generally evident. The effects of most marine mammals in the food chain are not directly measurable, and hence the benefits which attend their preservation are primarily non-market benefits. Even so, a recent model formulated by Fisher and Hanemann (1984) provides a theoretical basis for presuming to estimate positive benefits for ecosystem preservation through preventing extinction of species.

B. Valuing Animal Species: Previous Work

Very little research has been conducted to quantify the non-market benefits associated with animal species. 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 for example, 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 (e.g., Huppert/ Thomson estimate an annual aggregate consumer surplus value of $9.6 - $13.8 million for ocean partyboat fishing in California), these measures do not include preservation benefits which might exist. This is probably a non-issue in regards to many managed fish stocks and animal populations, but it may be a problem for estimating valuations for marine mammals where consumptive uses and perhaps even non-consumptive uses are minimal.

The contingent valuation method has been applied in a very small number of studies 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 hunters were asked by way of a mailed questionnaire to accept or reject a specific willingness to pay value (which was a different amount on each survey) for goose hunting permits in a Wisconsin wildlife preserve. (The State of Wisconsin provides a limited number of free permits, allocating them by lottery.) They reported a consumer surplus value for goose hunting of $880,000 based upon an average willingness to pay (WTP) equal to $63 per hunter (in 1978 dollars). By way of comparison, they asked other hunters to state their willingness to accept (WTA) compensation for the loss of permits, and derived an average value of $101. The WTP amounts were hypothetical whereas the WTA amounts were actually paid to respondents. Bishop/ Heberlein's comparative analysis used the travel cost method which provided a range of only $11-$45 as the average consumer surplus per goose hunter.

As discussed in the previous chapter, questions have been raised about the Bishop/Heberlein results. Carson and Mitchell (1983) point out that non-participants (i.e., those who did not respond to the mail survey) were viewed as participants; that is, they were included in the study as if they had reported that they would not pay a WTP amount or they were rejecting a WTA amount. In fact, researchers have found that even with financial

incentives, the best mail survey response rate is 90-95% (Karuck and Berenson, 1975), and in other instances non-participant rates of 50-70% in mail surveys is not uncommon. Furthermore, Bishop/ Heberlein's estimation procedures did not make any allowance for outliers, a problem which might be expected to occur in a contingent valuation survey of this type. For example, in the WTP analysis Bishop/Heberlein truncate their estimation at $200 because one respondent (out of 40 mailed) reported a WTP of $100 and two respondents (out of 41 mailed) reported a WTP of $150. When Carson/Mitchell re-estimated average WTP and WTA by truncating, instead, where response rates became statistically insignificant (as a means of eliminating non-participants and probable outliers) they found that average WTP may really have been between $10 and $14, whereas average WTA may have been between $20 and $51. Note that these re-estimated values are very close to Bishop/ Heberlein's range of $11-$45 derived by using the travel cost method. This result is significant in that it indicates first, the importance of identifying non-participants or "protest" responses and second, the large impact that inclusion of probable outliers can have on CVM results. Thirdly, the payment vehicle may have led to strategic behavior on WTP if respondents feared that the free permit would soon have a fee imposed. Carson/Mitchell suggest instead the use of a payment vehicle such as a conservation fund.

Another CVM study conducted by mail was reported by Brookshire, Eubanks, and Randall (1983). A sample of Wyoming hunters was asked to report annual willingness-to-pay to obtain a hunting permit for either 5 years or 15 years into the future. Some hunters were asked about a hypothetical situation where grizzly bear might possibly be available for hunting after one of these time horizons, and other hunters were asked similarly about bighorn sheep. The former is currently prohibited altogether under the Endangered Species Act, whereas the latter is permitted on a limited basis by way of a small number of licenses issued each year.

The Brookshire/Eubanks/Randall survey asked hunters to state willingness-to-pay in the context of future supply uncertainty; i.e., given some probability that the animal populations in question had recovered to levels sufficiently great to warrant the issuance of hunting permits. Results indicated average willingness-to-pay per year for grizzly bear permits of $10.00-$21.50 per year with a 5-year time horizon and $9.70-$25.90 per year with a 15 year horizon (the ranges are valuations reported for several scenarios where the chance of permit issuance was varied from 25-90%). Average annual willingness-to-pay for bighorn sheep permits under supply uncertainty ranged from $13.26-$22.90 (5-year horizon) and $11.18-$29.16 (15-year horizon). Finally, hunters who reported that they would not want to hunt the species were asked to report willingness-to-pay for preservation (the analysts do not report the payment vehicle used). Reported mean existence values were $15.20-$24.00 annually for grizzly bears and $6.90-$7.40 annually for bighorn sheep. If respondents specified a desire to observe the animals in the wild, their willingness-to-pay responses were interpreted fully as non-consumptive use values; these average valuations were $21.00-$21.80 for grizzly bear and $18.00-$23.00 for bighorn sheep. It is unclear if the survey used any incremental steps to assure reporting of maximum willingness-to-pay in any of the scenarios. Also, no controls are reported for identifying protest bids or outliers, which could explain some of the apparently anomalous

results.

Though the Brookshire/ Eubanks/Randall study is one of the first attempts to empirically assess not only use valuations but also non-use valuations, the data were obtained exclusively from hunters from whom valuation responses were elicited contingent upon a hypothetical hunting situation. If, in addition, hunters and non-hunters have preservation values for the animal species, these non-hunting values are not adequately identified.

Meyer (1980) has suggested an alternative valuation strategy for fish and wildlife. Based upon personal interviews conducted in central California, the study requested that respondents report household values for songbirds, water and shore birds, migrating fish, and animals using natural cover (e.g., deer and racoons). However, these were not willingness-to-pay values; rather, respondents were asked to simply state the annual worth of these fish and wildlife relative to current expenditures on local community services (police, welfare, roads, etc.). For each of three communities the mean responses were 39%, 44%, and 196%, respectively, of total expenditures on public services. Respondents were also queried about their hypothetical willingness-to-accept compensation for a loss of wildlife in their community. Average annual compensatory values per household were $551, $449, $457, and $546 for loss of each of the four animal groups, respectively, in the study area (with 40% of respondents unwilling to accept any amount of compensation).

The relatively large values reported in the Meyer study can be attributed perhaps to use of the survey's constraint-free approach of eliciting valuations. Meyers justifies this approach by positing that the appropriate analytical framework for estimating aesthetic values is use of supply theory, i.e., derivation of an "offer curve" instead of a demand curve. But, implicitly this approach assumes that the individuals queried about their willingness-to-accept payment currently possess the property rights with respect to the public good. Although such goods as public parks and wildlife are commonly viewed as belonging to everyone, a general conclusion from common property studies (see e.g., Hardin and Badin, 1977) is that property owned in "common" is, in fact, owned by no one. This means that the "ownership-in-common" nature of these goods prevents individuals from excluding others from use, which in turn means that no individual will assume responsibility for protection or maintenance of such goods.

This is an important observation because the supply curve (willingness-to-accept) for market goods (e.g., domestic cattle) is largely determined by owners' production and maintenance costs relative to market prices. On the other hand, determining a supply curve for common property goods (e.g., wild squirrels) is not supported by economic theory in that individuals have no ownership responsibilities and therefore are not required to consider <u>any</u> economic tradeoffs when reporting values. If supply curve analysis is to be used within the usual construct of opportunity costs foregone in production of the good, it would seem more theoretically correct to ask respondents how much they would be willing to forego (i.e., pay) to "produce" a level of the public good. This translates, for example, into a willingness-to-pay type of question to support public conservation/management programs of wildlife, since it would

be expected that the payment (or opportunity cost along the supply curve) would be equal to the benefit received at the margin.

If we consider Meyers' results from the demand analysis perspective instead, the willingness-to-accept approach is an equivalent variation measure of consumer surplus that is unconstrained by income. Again, this assumes that the property rights for the good are in the hands of the respondent. If this were in fact the case with wildlife then we would generally expect the owners to either maintain the animals privately or sell them in markets to those who would, as is the case with domestic animals. Thus, the common property problems of over-use and abuse generally would not exist, nor would issues regarding public conservation/management. Furthermore, evidence from other studies has led to a general consensus that WTA questions do not elicit appropriate value measures. (See Section II.3.a. of this report, as well as a summary report on the state-of-the-art of the CVM in Cummings et al., 1984.) It would seem that responses such as those reported by Meyers are useful for providing information on whether or not values for wildlife conservation exist; however, valuations which do not require respondents to consider economic trade-offs can not be theoretically justified as measures of benefit estimates for public programs which must consider economic trade-offs.

Finally, Stoll and Johnson (1984) conducted a willingness-to-pay survey for a whooping crane population which can be viewed at the Aransas National Wildlife Refuge in Texas during part of each year. Questionnaires were distributed to on-site visitors and mailed to Texas residents and out-of-state residents. Protest bids were identified and removed, but no correction for outliers was made. Preliminary results indicate a mean annual use value of $1.40 per respondent (as a hypothetical entrance fee to the refuge, the amount over and above a reported willingness-to-pay of $3.07 to visit the refuge without whooping cranes). Willingness-to-pay estimates were also elicited in the form of a hypothetical contribution to a preservation fund, contingent upon a hypothetical withdrawal of public funding. Mean values reported by individuals who indicated a desire to visit the refuge are deemed option price and range from $10.67 per year for Texas residents to $16.87 per year for refuge visitors. Willingness-to-pay by individuals who did not expect to visit the refuge in the future resulted in a mean existence value of $1.03 per year for Texas residents and $9.33 per year for current refuge visitors.

C. Valuing Marine Mammal Populations: The Existence of Existence Value

The Johnson/Stoll study of whooping cranes was the first to elicit benefit valuations from both non-consumptive users and non-users for an endangered animal species. Their approach can be applied to the problem of valuing societal benefits associated with marine mammal populations. However, the whooping crane study looks at one isolated bird species which is very endangered and which imposes no perceptible direct costs on human activity. Furthermore, respondents were aware of the exact location of the whooping cranes if non-consumptive use (observation) was desired. Some of these circumstances will be true for some marine mammals; however, accessibility to marine species in the wild may be limited. Indirect exposure through television and books may differ from that experienced with

whooping cranes. Thus, the WTP measures obtained in the whooping crane survey can not be expected a priori to apply to marine mammals.

The section which follows describes the CVM approach used to elicit valuations for marine mammal populations. Before proceeding, it is useful to outline the types of benefits for which marine mammals are valued. Mendelsohn (1984) has compiled an appropriate 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 (from Table 1 in Mendelsohn, 1984, p.3). After a generally persuasive discussion of each, Mendelsohn argues that only use values are relevant for measurement of the benefits of preserving endangered species. The utilitarian argument is that all other values, such as option value or existence value, are in fact use values captured in benefits elsewhere. For example, the argument is posited that existence value does not exist, and that if people were allowed no information on the animal stock (precluding of course visits in the wild, but also media information), then willingness-to-pay for blind faith in the animals' continued existence would be zero.

In the section which follows, we take issue with the strictly utilitarian approach to value measurement. It may be true that existence value is zero when it is narrowly defined to preclude all direct and indirect exposure to the animal or information about the animal, but this is conjecture. Even if we accept the conjecture, the question arises as to how, then, are non-use values to be measured? Mendelsohn argues that these values are captured in payments for movies, television documentaries, live zoo and aquarium exhibits, and books. However, any effort to enumerate the large number of media exposures for any particular animal and then ascertain the total willingness-to-pay for that species would generally be such an enormous task as to render it an impossible endeavor. Furthermore, casual conversation with individuals concerned about wildlife protection will reveal that there are those people who adamantly claim their values are not 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 required for their own 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. By direct non-consumptive use, we are referring to current or future on-site observation of animal species. The distinction is important because it allows individuals to indicate their demand for the public good even though current or future uses are not intended. In this way, benefit estimates for species preservation need not be tied necessarily to recreational use.

IV. 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 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.)

A copy of survey materials is provided in the Appendix to this section. A description of the survey follows, as well as a discussion of practical and methodological issues which were addressed in the survey's development and implementation.

A. Survey Description

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[11]. This scenario was dated to show when excessive hunting of the animal began off the California 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[12] under protective legislation.

D. a population level which reflects a best estimate of the historical low number of animals when hunting was allowed[13]. 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) History: A brief discussion of the animals and information on on whether or not they have been considered to be in danger because of human and/or natural causes.

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

(6) Worldwide: 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) Seeing the animal: How accessible the animals are for viewing and 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 each 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

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[11]Antonelis et al. (1981), Cohen (1981), Cooper and Stewart (1983), Daugherty and Schuyler (1979), Gaskin (1982), Hansen (1983), Leatherwood et al. (1982), and U.S. Fish and Wildlife Service (1981).

[12]See footnote 11 for data sources.

[13]See footnote 11 for data sources.

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 the 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.

B. 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 of avoiding 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 be 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 responses 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 9 plus 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 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 household, 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 analysis 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 5. 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). In this case, the property rights do not rest with the respondent. However, the respondent may also be asked to state a willingness-to-pay to obtain an improvement from X_0 to X_1. The compensating variation measure (CV_I) will be equal to 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 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 5. Since $EV_D=CV_I \leq EV_I=CV_D$, 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 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.

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.

7. 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 of avoiding 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 be 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.

Information Bias

Given our desire to encourage a higher response rate by limiting the survey's length, we provided as much information 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.

APPENDIX TO SECTION IV

SURVEY MATERIALS

DEPARTMENT OF ECONOMICS
COLLEGE OF ARTS AND LETTERS
SAN DIEGO STATE UNIVERSITY
SAN DIEGO CA 92182

(619) 265-5471

Respondent's Name
Street Address
City, CA Zip

July 22, 1984

Currently, all mammals living in the ocean (whales, dolphins/porpoises, sea otters and seals/sea lions) are protected by federal law. Protection programs are being followed because of a fear that some of these animal populations might be hunted or displaced by human activity until they are no longer found in our coastal waters. Many people believe that these types of programs can greatly affect the quality of life provided in both coastal states and the nation. However, no one really knows how much households like yours feel they benefit from such programs.

Your household is one of a small number in which people are being asked to give their opinions on these matters. It was chosen from a random sample of the entire state. In order that the results will truly represent the thinking of the people of California, it is very important that each answer sheet be completed and returned. Please fill our and return the two yellow sheets only. We would like any adult member of your household to completethe questions, but please feel free to ask any member(s) of your family to help you determine the answers for your household.

You may be assured of complete confidentiality. This is an opinion poll and will not be used for any commercial proposes. The answer sheets have an identification number for mailing purposes only This is so we can check your name off the mailing list when your answers arrive. Your name will never be placed on the answer sheets.

As I am sure you are aware, economic pressures are forcing our government to decide which programs the public feels are most beneficial and should be provided. Your family's opinion should be considered. It is important information needed to better understand how much people value the marine mammals living in our coastal waters. The results of this research will be made available to official and representatives of our state and federal government, members of Congress, and all interested citizens.

If you would like to receive a summary of results from this research, please write "copy of results requested" on the back of the return envelope. Also, I would be happy to answer any questions you might have; you may contact me at the telephone number or address at the top of this letter.

Thank you in advance for your assistance.

Sincerely,

Ronda K. Hageman

Ronda K. Hageman
Project Director

DEPARTMENT OF ECONOMICS
COLLEGE OF ARTS AND LETTERS
SAN DIEGO STATE UNIVERSITY
SAN DIEGO CA 92182

(619) 265-5471

September 5, 1984

Dear Concerned Californian;

Last month I wrote to you seeking information on your experience and views regarding the marine mammals living off our coast. We have not yet received your completed answer sheets.

We are conducting this study because of a belief that citizen views should be taken into account when public policy is formed which affects coastal resources such as marine mammals. No matter whether you are in favor of or opposed to such policies, your preferences can be made known to state and federal policmakers when you participate in this study.

I am writing to you again because of the significance each questionnaire has to the usefulness of the study. Out of all the households in California, only 1 out of 7500 families was chosen using scientific methods to select a random sample. So, our ability to accurately describe how Californians value government policies which affect marine mammals depends upon you and others who have not yet responded. This is because our past experiences suggest that those of you who have not yet sent your answers may have quite different preferences than those who have.

This is the first statewide study of this type which has ever been done. Therefore, the results are of particular importance to the many citizens, community planners, and lawmakers now considering what kinds of government programs should be pursued so as to best meet the wants of families such as yours. The usefulness of our study depends on how accurately we are able to describe what the people of California believe.

In the event that your questionnaire has been misplaced, a replacement is enclosed. Please fill out the two yellow sheets only and return them in the self-addressed, stamped envelope provided.

Your cooperation is greatly appreciated.

Cordially,

Ronda K. Hageman

Ronda K. Hageman
Project Director

P.S. Many people have written to ask when the results will be available. We hope to have them out sometime next month. If you would also like to receive a summary of results, please write "Copy of results requested" on the back of the return envelope when you mail us your completed yellow answer sheets.

INSTRUCTIONS

On the following two pages, you will find information on four types of mammals which live in the ocean off the California coast. These are gray whales, bottlenose dolphins, California sea otters, and northern elephant seals. With each group is a representative picture and some information on four aspects of each animal:

History: 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. This information is accompanied by a chart showing how many of these animals have lived off the California coast since humans began settling here.

Current population: Estimates of the numbers of animals off the California coast and how these populations are changing.

Worldwide: 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?

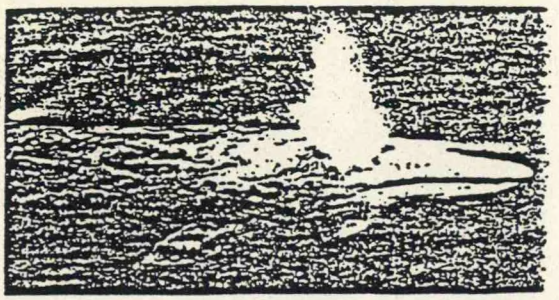
Seeing the animal: How accessible the animals are for viewing or photographing in the wild. There is a map to show you where these animals are found. Also, you can get some idea of your chances of seeing one of the animals from the information on how many animals there are per square mile of ocean near the shoreline.

After you have read about all four groups of animals, please turn to the following page, entitled SPECIAL MARINE MAMMALS SURVEY.

When answering the Special Marine Mammals Survey, please use the first yellow answer sheet to record your responses. Answer all questions for gray whales in column A of the answer sheet, answer all questions for the bottlenose dolphins in column B, column C for California sea otters, and column D for northern elephant seals.

When you have answered all questions, please return to us only the two yellow sheets, using the self-addressed, stamped envelope enclosed.

GRAY WHALES



Numbers Off California's Coast

A: before 1800 — 24,000(?)

B: 20,000

C: 1984 (protection) — 16,000

D: 1875 (no protection) — 1,300

History: Before 1800, gray whales probably numbered 24,000. Although North American natives hunted them somewhat, extensive European whale hunts began in 1857. Only 1,300 whales survived by 1875, and killing of gray whales ceased in 1980 because the species was believed to be extinct. When gray whales were later found, extensive hunting resumed in the 1920's. However, hunting gray whales was outlawed in 1946 because, again, the animal was thought to be nearly extinct.

Current Population: About 16,000 gray whales now travel along California's coastline. It is estimated that this population is growing by 3%/year.

Worldwide: This population migrates from cold northern feeding grounds to breed in warm Mexican lagoons. These are probably the only gray whales left in the world. There was once a group off Korea, but they are now believed to be extinct.

Seeing the Animal: Gray whales can be seen along the entire California coast. They travel southward, traveling quite close to the coastline between December and February, but can also be seen further out in late spring.

Situation C: Currently, there are about 3.8 animals/square mile of ocean during this period.
D: No chance of seeing the animal.
B: 4.7 animals/square mile of ocean.
A: 5.6 animals/square mile of ocean.

BOTTLENOSE DOLPHINS

Numbers Off California's Coast

A: 1,000

B: before 1850 — 840 (?)

C: 1984 — 700

D: 350

History: Little is known about past populations of bottlenose dolphins in California. There have been reports that the animals were perhaps somewhat more abundant than today since more sightings of the animals occurred in the early 1900's in areas which are heavily developed today, such as San Diego's harbor. But no real evidence that the numbers of animals has declined exists. The animals have never been hunted commercially, but they are one of the most popular animals captured alive and shown at exhibits such as San Diego's Sea World. Each year, a very limited number of permits are issued to allow capture of bottlenose dolphins for these types of live exhibits.

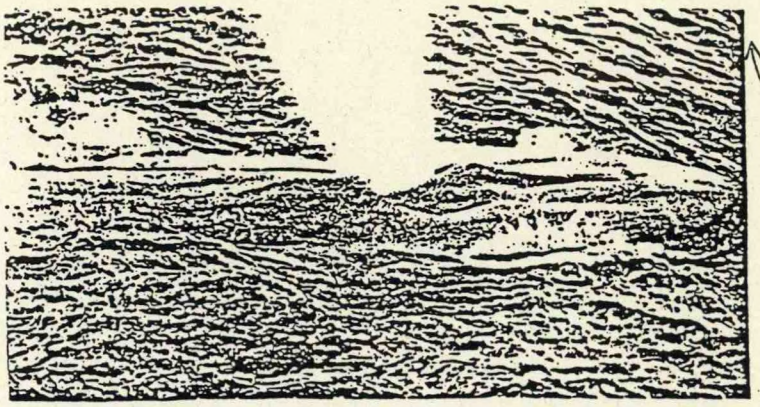
Current Population: Two fairly separate populations live off of the Southern California coast. One group of about 250 animals lives within 300 yards of the shore between Long Beach and down into the Baja. Another group of perhaps 450 animals lives further from shore, concentrated around Catalina Island. These populations may be growing at about 4% per year at this time, and probably have not changed very much since before human settlement of the area.

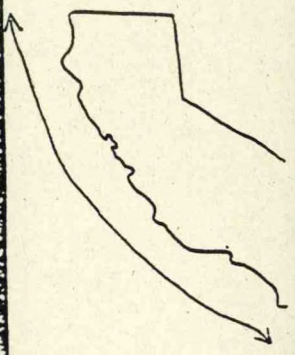
Worldwide: Although some people believe the California dolphins are distinct from other types of bottlenose dolphins, the National Marine Fisheries Service of the U.S. recognizes only one type of bottlenose dolphin throughout the world. These animals are very abundant all over the world's oceans, and do not appear to be disturbed by human activity.

Seeing the Animal: Because these dolphins live so near to the shore or to Catalina Island, they are one of the most commonly observed marine mammals in Southern California.

Situation C: Currently, there are roughly 10 animals/square mile of ocean near the shore, and .2 animals/square mile of ocean around Catalina Island.
D: 5.4 animals/square mile of ocean near shore; .1/square mile near Catalina Is.
B: 13 animals/square mile of ocean near shore; .25/square mile near Catalina Is.
A: 16 animals/square mile of ocean near shore; .3/square mile near Catalina Is.

BLUE WHALES





Numbers Off California's Coast

A — before 1900 / 10,000(?)

B — 2,580

C — 1984 (protection) / 1,290 (?)

D — 1939 / 500(? no protection)

History: The blue whale is the largest living animal. It has been hunted extensively since the early 1900's, primarily in feeding grounds in cold northern and southern waters, but also in the Pacific and Atlantic Oceans. The worldwide population was probably well over 100,000 before hunting began. Since we know very little about past or current numbers of blue whales, we can only guess that before extensive hunting began perhaps 10,000 blue whales migrated annually along the California coast. When many scientists believed that there was little chance of saving the world's blue whales from extinction, an international ban on killing these whales was agreed upon in 1965.

Current Population: Very little is known about blue whales because they are extremely rare today. Also, they can swim very fast and dive very deep. Some scientists believe that so few blue whales exist at this time that they will probably become extinct. Other scientists believe that the animals have begun to recover, especially the population living in this part of the world. One estimate is that perhaps a thousand or more migrate off California's coast because researchers have seen them outside the Channel Islands and in Monterey Bay. However, no clear increase in the population has been determined.

Worldwide: Very little is known. Estimates have been made that several thousand exist, but no clear increase in population size has been determined.

Seeing the Animal: Because of their extreme rareness, there is probably no chance of seeing the animal currently or in any of the situations shown except possibly in Situation A.

BOTTLENOSE DOLPHINS

Numbers Off California's Coast

A — 1,000

B — before 1850 / 840 (?)

C — 1984 / 700

D — 350

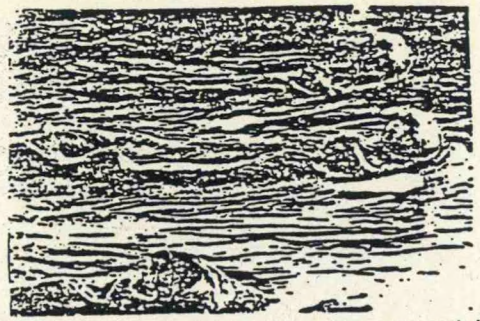
History: Little is known about past populations of bottlenose dolphins in California. There have been reports that the animals were perhaps somewhat more abundant than today since more sightings of the animals occurred in the early 1900's in areas which are heavily developed today, such as San Diego's harbor. But no real evidence that the numbers of animals has declined exists. The animals have never been hunted commercially, but they are one of the most popular animals captured alive and shown at exhibits such as San Diego's Sea World. Each year, a very limited number of permits are issued to allow capture of bottlenose dolphins for these types of live exhibits.

Current Population: Two fairly separate populations live off of the Southern California coast. One group of about 250 animals lives within 300 yards of the shore between Long Beach and down into the Baja. Another group of perhaps 450 animals lives further from shore, concentrated around Catalina Island. These populations may be growing at about 4% per year at this time, and probably have not changed very much since before human settlement of the area.

Worldwide: Although some people believe the California dolphins are distinct from other types of bottlenose dolphins, the National Marine Fisheries Service of the U.S. recognizes only one type of bottlenose dolphin throughout the world. These animals are very abundant all over the world's oceans, and do not appear to be disturbed by human activity.

Seeing the Animal: Because these dolphins live so near to the shore or to Catalina Island, they are one of the most commonly observed marine mammals in Southern California.
Situation C: Currently, there are roughly 10 animals/square mile of ocean near the shore, and .2 animals/square mile of ocean around Catalina Island.
D: 5.4 animals/square mile of ocean near shore; .1/square mile near Catalina Is.
B: 13 animals/square mile of ocean near shore; .25/square mile near Catalina Is.
A: 16 animals/square mile of ocean near shore; .3/square mile near Catalina Is.

CALIFORNIA SEA OTTERS



Numbers Off California's Coast

A — before 1785: 16,000

B — 3,000

C — 1984 (protection): 1,500

D — 1911: 100 (no protection)

History: Before European fur trading began in 1785, there were probably at least 150,000 sea otters living off Baja California up the coastline to Alaska and Russia. Of these, perhaps 16,000 lived off California's coast. Extensive hunting led to the belief that sea otters were nearly extinct by 1911. In that year, an international agreement banned hunting of sea otters.

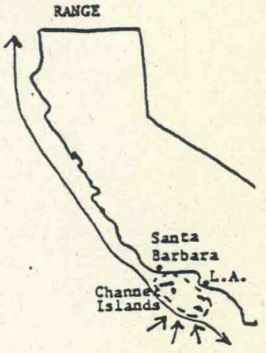
Current Population: Today, it is estimated that about 1,500 sea otters live off California's coast between Santa Cruz and Point Conception. The level of their growth in numbers is not well understood, but currently the population does not seem to be increasing. If it were to increase, the animals' range would probably increase farther along the coastline.

Worldwide: Some scientists believe that the California sea otter is the only one of its kind in the world. There is a large population of otters (150,000) living off the coast of Alaska, but it is uncertain as to whether or not they are the same type of sea otter as the ones living in California. Also, some people believe that an oil spill near California could reduce the number of animals here to near extinction. (This has not been proven, though it is known that oil in the fur of sea otters makes it almost impossible for the animal to survive.) For these reasons, the California sea otter has been placed on the "Threatened" list under the U.S. Endangered Species Act.

Seeing the Animal: California sea otters are found along the coastline between Santa Cruz and Point Conception (almost to Santa Barbara.)

Situation C: Currently, there are roughly 3.5 animals/square mile of ocean along this range.
D: No chance of seeing an animal.
B: 7 animals/square mile of ocean (though the range would probably increase).
A: 9.4 animals/square mile of ocean (though the range would probably increase).

NORTHERN ELEPHANT SEALS



Numbers Off California's Coast

A — before 1800: 50,000

B — 45,000

C — 1984 (protection): 40,000

D — 1900: less than 100 (no protection)

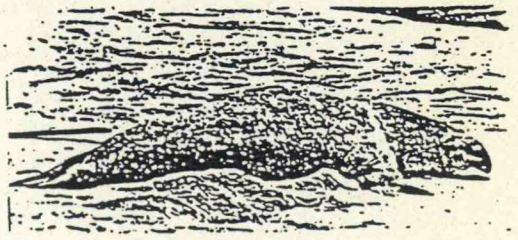
History: Northern elephant seals were once very abundant. Perhaps 100,000 lived between northern California and Baja. They were hunted so extensively in the early 1800's that by 1880 they were believed to be extinct. However, a few survived in Mexico, but they did not return to California to breed until after 1950.

Current Population: About 40,000 northern elephant seals now live on various islands off California. They are also beginning to appear on many beaches along the entire coastline. This population is growing at about 13% per year.

Worldwide: The only other northern elephant seals in the world live around Mexican islands. About 40,000 live there, so that half of the world's northern elephant seals are currently found in California.

Seeing the Animal: These animals are found along the entire coast of California, but are heavily concentrated around the Channel Islands.

Situation C: Currently, there are roughly 8 animals/square mile on and around the Channel Islands area.
D: No chance of seeing the animal.
B: 9 animals/square mile
A: 10 animals/square mile



SPECIAL MARINE MAMMALS SURVEY

* As you begin answering, PLEASE DO NOT PUT YOUR ANSWERS ON THIS QUESTIONNAIRE, BUT USE THE FIRST YELLOW ANSWER SHEET.

* Please answer all questions in the column marked A of the yellow answer sheet for GRAY WHALES only. When you have finished, you will return to this point again and answer these same questions for the next animal shown.

PART I. SEEING THE ANIMAL

1. Has any member of your household seen any television documentaries or magazine/news-paper stories about these animals?

2. Has any member of your household seen any of these animals living in captivity, such as in California's Sea World or Chicago's Aquarium?

3. Has any member of your household observed any of these animals living wild in the ocean?

4. Did any household member see this animal living in the wild when a trip was made to a California beach in 1983? (If you live or work daily at the beach, please do not count this as a trip.)

   If NO, please skip to Part II marked IMPORTANCE OF THIS ANIMAL. (go to next page)
   If YES, please continue to Question 5.

5. If you count only the trips during which a household member observed this animal in the wild, please estimate how many trips, on average, you made in 1983 to the California coast and also observed this animal.

6. Only for trips during which a household member observed this animal in the wild, please estimate the average distance you traveled one way in 1983 to the California coast. If you took a boat from there to observe this animal, please show this also.

7. For a typical trip during which this animal was observed in the wild in 1983 off the California coast, how many persons were in your party?

8. People pay for experiences on the California coast by spending money to travel there. Expenditures on gasoline, auto tires/repairs and boat trips are made because many people enjoy sun-tanning, swimming, visiting local attractions, and observing this animal. For example, when a family spends money on attending a baseball game, a portion of the expenditure is for hotdogs and popcorn, a portion is for parking, a portion is for box seats. Suppose your household could also put travel expenditures to the California coast into the categories of activities they enjoy. Please circle the choice below which best represents the portion of your travel expenditures on a typical trip to the coast which represents the share of your trip cost that you believe was devoted to seeing this animal.

   A. 0% B. 1-9% C. 10-30% D. 40-80% E. 90-100%

Please turn to the next page and continue to PART II for this same animal.

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 of avoiding 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 be 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 responses 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 9 plus Question 10. Please write this total next to #11 on your answer sheet.

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.

Please turn to the next page and answer Questions 13-17 for this same animal.

13. People value public programs for many reasons. One of the purposes of this study is to try and find out about these reasons. The next three questions provide us with information on how your household values a protected ocean animal. PLEASE READ THROUGH QUESTIONS 13a, 13b and 13c FIRST. THEN, BREAK DOWN THE TOTAL VALUE YOU GAVE TO QUESTION 11 INTO THE THREE CATEGORIES. PLEASE REMEMBER THAT WHEN YOU ADD UP YOUR ANSWERS TO 13a, 13b and 13c, THEY SHOULD EQUAL THE TOTAL VALUE YOU GAVE FOR QUESTION 11.

    13a. Of the amount you gave in Question 11 above, how much of this (in dollars) do you feel you are paying for your personal observation experiences--actually seeing this animal living wild off California's coast? NOTE: IF YOU HAVE NEVER SEEN THIS ANIMAL LIVING OFF CALIFORNIA'S COAST, PLEASE ANSWER 0 TO THIS QUESTION.

    13b. Whether or not you have seen this animal in the wild, how much do you feel you are paying for the fact that you or your children may someday want to see this animal in the wild? (For example, some people buy season tickets to football games to reserve the right to see a team, even though they may not actually attend.)

    13c. If you or your children never again saw this animal living wild off the coast of California, yet would still be assured that Situation C would exist rather than Situation D, how much of the amount in Question 11 do you feel you are contributing simply because you want to know this animal population continues to live off the California coast?

Before continuing, please make certain that when you add up your answers to Questions 13a, 13b and 13c, you come up with the total figure you wrote next to Question 11.

14. Consider for a moment your household's budget. Some of the expenditures which you are currently making would have 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¢/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

Please turn to the next page and answer Questions 16 17 for this same animal.

16. In Question 11 you estimated an amount to prevent Situation D and remain at Situation C. Suppose now that with further funds collected, the situation could be improved to Situation B. Please choose an amount from the payment choices at the bottom of the yellow answer sheet which most closely estimates any additional amount (over and above the amount you gave in Question 12) you would contribute in order to move to Situation B. As always, if the protection fund was actually collected, you would pay an average of all households' responses. PLEASE REMEMBER, THIS IS IN ADDITION TO YOUR ANSWER TO QUESTION 11.

17. Suppose now that additional funds could allow this animal's population to grow to the level shown in Situation A. You have estimated amounts you would be willing to pay for Situations C and B. Now, how much additional amount per year would you be willing to pay into the fund for this animal to achieve Situation A? (Please choose your answer from the payment choices at the bottom of the yellow answer sheet.)

NOW, PLEASE RETURN TO #1 OF THIS QUESTION SHEET AND ANSWER ALL QUESTIONS IN THE NEXT COLUMN OF THE ANSWER SHEET FOR THE NEXT ANIMAL SHOWN. WHEN YOU HAVE COMPLETED ALL COLUMNS, PLEASE ANSWER A FEW REMAINING QUESTIONS ON THE LAST YELLOW SHEET.

ANSWERS TO SPECIAL MARINE MAMMALS SURVEY "Identification No."

INSTRUCTIONS	A. GRAY WHALES	B. BOTTLENOSE DOLPHINS	C. CALIFORNIA SEA OTTERS	D. NORTHERN ELEPHANT SEAL
1. CIRCLE ONE	1. Yes No	1. Yes No	1. Yes No	1. Yes No
2. CIRCLE ONE	2. Yes No	2. Yes No	2. Yes No	2. Yes No
3. CIRCLE ONE	3. Yes No	3. Yes No	3. Yes No	3. Yes No
4. CIRCLE ONE	4. Yes No	4. Yes No	4. Yes No	4. Yes No
5. NUMBER	5. _____	5. _____	5. _____	5. _____
6. MILES (CAR)	6. _____ BY CAR	6. _____ BY CAR	6. _____ BY CAR	6. _____ BY CAR
MILES (BOAT)	_____ BY BOAT	_____ BY BOAT	_____ BY BOAT	_____ BY BOAT
7. NUMBER	7. _____	7. _____	7. _____	7. _____
8. CIRCLE ONE	8. A B C D E	8. A B C D E	8. A B C D E	8. A B C D E
9. DOLLARS/YR	9. $_____/yr	9. $_____/yr	9. $_____/yr	9. $_____/yr
10. DOLLARS/YR	10. $_____/yr	10. $_____/yr	10. $_____/yr	10. $_____/yr
11. DOLLARS/YR	11. $_____/yr	11. $_____/yr	11. $_____/yr	11. $_____/yr
12. CIRCLE ONE	12. A B C D E	12. A B C D E	12. A B C D E	12. A B C D E
13a. DOLLARS/YR	13a. $_____/yr	13a. $_____/yr	13a. $_____/yr	13a. $_____/yr
13b. DOLLARS/YR	13b. $_____/yr	13b. $_____/yr	13b. $_____/yr	13b. $_____/yr
13c. DOLLARS/YR	13c. $_____/yr	13c. $_____/yr	13c. $_____/yr	13c. $_____/yr
14. CIRCLE ONE	14. Yes No	14. Yes No	14. Yes No	13. Yes No
14a. DOLLARS/YR	14a. + $_____	14a. + $_____	14a. + $_____	14a. + $_____
	OR - $_____	OR - $_____	OR - $_____	OR - $_____
15. CIRCLE ONE	15. A B C D E	15. A B C D E	15. A B C D E	15. A B C D E
16. DOLLARS/YR	16. $_____/yr	16. $_____/yr	16. $_____/yr	16. $_____/yr
17. DOLLARS/YR	17. $_____/yr	17. $_____/yr	17. $_____/yr	17. $_____/yr
	Please return to Question #1 and answer all questions for bottlenose dolphins.	Please return to Question #1 and answer all questions for California sea otters.	Please return to Question #1 and answer all questions for northern elephant seals.	Please turn to the second (and last) answer sheet.

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

"Identification Nc

ANSWER SHEET #2: ABOUT YOU

Please answer a few questions about your household. Remember that all answers are confidential and your name will never be placed on the answer sheet. UNLIKE THE PREVIOUS QUESTIONS, PLEASE PLACE YOUR ANSWERS TO THE FOLLOWING QUESTIONS ON THIS SHEET.

18. How many people are currently residing in your household? _____ PEOPLE

19. What is your present age? _____ YEARS

20. Your sex: M F (circle one)

21. Are you presently: (circle the letter)

A. EMPLOYED
B. UNEMPLOYED
C. RETIRED
D. FULL-TIME HOMEMAKER
E. STUDENT

22. Which of the following categories represents your household's yearly income? (circle one)

A. LESS THAN $4,000
B. $4,000-$9,999
C. $10,000-$19,999
D. $20,000-$39,999
E. $40,000 OR ABOVE
F. OVER $60,000

23. How many years of education have you completed? _____ YEARS

24. Do you or any adult in your household hunt or fish? YES NO (circle one)

25. Are you or any adult in your household a member of an environmental group? (circle one)

YES NO

The following are what might be called Avidity Scales. "Avidity" is defined as the level of desire, eagerness, or enthusiasm you associate with an activity or an issue. Please circle the number on the scale which best describes the level of avidity you feel for each of the following: "0" is None "10" is Extreme Avidity

26. Swimming, sailing, surfing, sunning at the beach

0 1 2 3 4 5 6 7 8 9 10

27. Ocean activities which require a motorized boat

0 1 2 3 4 5 6 7 8 9 10

28. Fishing for sport (for example, shellfish and billfish) in the ocean

0 1 2 3 4 5 6 7 8 9 10

29. Protection of ocean animal populations

0 1 2 3 4 5 6 7 8 9 10

30. Protection of any animal population if endangered

0 1 2 3 4 5 6 7 8 9 10

31. Preservation of "wilderness" types of areas where no human development or machinery are allowed

0 1 2 3 4 5 6 7 8 9 10

V. 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).

A. 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 I.

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

H_o: $\text{Dolphins}_G = \text{Dolphins}_B$ (-0.167,173)

H_o: $\text{Sea Otters}_G = \text{Oea otters}_B$ (-0.162,172)

H_o: $\text{Elephant Seals}_G = \text{Elephant Seals}_B$ (-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 I) 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 II error, the entire sample was used for analysis in the discussion which follows.

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. 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 have 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¢/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

The t-statistics calculated for this difference are also reported by species in

Table 4.

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 of 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 matrices for WTP, by species, and the socio-economic variables are shown in Tables 5, 6, 7 and 8. 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.

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 a 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.

The B-K-W statistic has the following form:

$$BKW_{ij} = B_j - B_{(n-i),j} = \frac{(X^TX)^{-1}x_{ij}^Te_{ij}}{1 - h_{ij}}; \quad \begin{matrix} i = 1, \ldots, n \text{ observations} \\ j = 1, \ldots, m \text{ independent variables} \end{matrix}$$

B_j = the jth estimated coefficient with n observations included

$B_{(n-i),j}$ = the jth estimated coefficient with the ith observation excluded

X = the (nxm) matrix of independent variables

e_{ij} = the ordinary least squares residuals

$h_{ij} = x_{ij}(X^TX)^{-1}x_{ij}^T$

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 ± Q14a
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

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 this 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. For the actual questions, the reader is referred to the questionnaire in the Appendix to Section IV.

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's coast in 1983 yes = 1; no = 0 (whales, dolphins, 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 an 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

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% for all groups except the northern elephant seal about which only 60% had previous information. Of interest are the number of yes response 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 otter (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, or 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 California 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.

The overall mean WTP across all species is $20.21. Since 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.)

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.

The WTP responses reported in Table 10 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 (before hunting by non-natives). The WTP responses to the questions (Question 16: C -> B, Question 17: B -> A) are shown in Table 11. Again, it appears that responses are generally higher for whales and sea otters than for dolphins and elephant seals.

B. Observer Data

Observer and travel data for 1983 are reported in Table 12, by species. Seventeen per cent of the sample reported having observed whales and dolphins in the wild after traveling to the California coast, whereas more than 26% observed wild California sea otters, and 11% reported viewing elephant seals in the wild. (Again, it should be remembered that some individuals may have reported on-site observation of <u>any</u> seal/sea lion species).

Of special interest are the responses to Question 8:

8. People pay for experiences on the California coast by spending money to travel there. Expenditures on gasoline, auto tires/repairs and boat trips are made because many people enjoy sun-tanning, swimming, visiting local attractions, and observing this animal. For example, when a family spends money on attending a baseball game, a portion of the expenditure is for hotdogs and popcorn, a portion is for parking, a portion is for box seats. Suppose your household could also put travel expenditures to the California coast into the categories of activities they enjoy. Please circle the choice below which best represents the portion of your travel expenditures on a typical trip to the coast which represents the <u>share of your trip cost</u> that you believe was devoted to seeing this animal.

A. 0% B. 1-9% C. 10-30% D. 40-80% E. 90-100%

As can be seen by inspection of the final column in Table 12, some individuals allocated 0% (A) of their trip cost to siting experience. However, on average the allocation of travel costs to whales is 31%, with an average of 15%, 19%, and 10% allocated to the experience of on-site observation of dolphins, sea otters, and elephant seals, respectively. These responses provide further evidence that, indeed, Californians are willing to pay some amount for the presence of marine mammals, and some do so by traveling to observe the animal populations at coastal sites.

VI. CONCLUSIONS, CAVEATS, AND RECOMMENDATIONS FOR FUTURE RESEARCH

A. <u>The Existence of Existence Value</u>

In order to investigate the nature of households' WTP estimates, Question 13 asked respondents to break down their valuations into the type of benefit received:

13. People value public programs for many reasons. One of the purposes of this study is to try and find out about these reasons. The next three questions provide us with information on how your household values a protected ocean animal. PLEASE READ THROUGH QUESTIONS 13a, 13b and 13c FIRST. THEN, BREAK DOWN THE TOTAL VALUE YOU GAVE TO QUESTION 11 INTO THE THREE CATEGORIES. PLEASE REMEMBER THAT WHEN YOU ADD UP YOUR ANSWERS TO 13a, 13b and 13c, THEY SHOULD EQUAL THE TOTAL VALUE YOU GAVE FOR QUESTION 11.

13a. Of the amount you gave in Question 11 above, how much of this (in dollars) do you feel you are paying for your personal observation experiences—actually seeing this animal living wild off California's coast? NOTE: IF YOU HAVE NEVER SEEN THIS ANIMAL LIVING OFF CALIFORNIA'S COAST, PLEASE ANSWER 0 TO THIS QUESTION.

13b. Whether or not you have seen this animal in the wild, how much do you feel you are paying for the fact that you or your children may someday want to see this animal in the wild? (For example, some people buy season tickets to football games to reserve the right to see a team, even though they may not actually attend.)

13c. If you or your children never again saw this animal living wild off the coast of California, yet would still be assured that Situation C would exist rather than Situation D, how much of the amount in Question 11 do you feel you are contributing simply because you want to know this animal population continues to live off the California coast?

Before continuing, please make certain that when you add up your answers to Questions 13a, 13b and 13c, you come up with the total figure you wrote next to Question 11.

The average responses for the breakdown of willingness-to-pay into use and non-use categories are presented in Table 13. The numbers in parentheses indicate the percentage of maximum willingness-to-pay reported in the answers to Question 11 (outliers have been excluded). The results shown in Table 13 indicate that current "use" and the option for future use are not necessarily major factors in individuals' determination of WTP (which reflects perceived benefits from protecting current marine mammal stocks). In all cases, the option for future use accounts for slightly less than 25% of value, whereas existence value accounts for more than 50% of reported values. Use, or on-site observation, is slightly more important for California sea otters and slightly less important for northern elephant seals, which is not unexpected since the former is known to be accessible for viewing.

B. Willingness-to-Pay as a Measure of Program Benefits

In Table 9 of the previous chapter, evidence was provided from the contingent valuation survey that the average willingness-to-pay per household in the response set 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 with 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 Californian 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:

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

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 stating their maximum WTP values because they did not significantly adjust their bids when given the opportunity to re-evaluate within their income constraint. Also, individuals' behavior was in accord with theoretical precepts; i.e., 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.

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.

C. The Success of the CVM in a Mail Survey

The response rate of 21% was reasonable, given that the survey was fairly long and complex, and that the individuals which received it were not previously identified as having any special interest in its topic. The second mailing, a reminder card, was crucial for increasing the response rate. The third mailing (a second copy of all survey materials) increased the response rate by 40%, though we found that respondents' answers received after the last mailing were not significantly different from those received previously.

Recommendations for improving response rates are as follows:

- A promise of some reward, even just a goodwill promise to send study results, appears to be useful in soliciting responses. 27% of respondents in this study requested a copy of results.

- In a willingness-to-pay study such as this, it is important to be extremely clear and detailed in explaining the purpose/intent of the study. We received more than one response which indicated that individuals valued marine mammals but were unable to make a donation. For this reason, in order to avoid free riders or misunderstanding, the hypothetical nature of the discussion of dollar values should be made very clear, both in the introductory materials and throughout the questionnaire.

- This study was ambitious in its attempt to elicit values for four different mammals. This entailed the mailing of a relatively large amount of information and materials, which was probably responsible for discouraging respondents due to the bulk and length which appeared to represent a potentially large time/effort commitment. The problem was unavoidable because of this study's goals; however, as Dillman (1978) suggests, a booklet questionnaire upon which respondents fill out answers is probably less overwhelming at first glance, if the survey is short enough to utilize this format.

D. Collecting Travel Cost Data from Mail Surveys

The number of responses on travel to observe marine mammals limits the conclusions which can be drawn from this portion of the study. However, there is evidence that individuals' travel behavior from a variety of locations indicates a willingness-to-pay for the observation experience. Of particular interest are the data on travel expenditure allocations. Respondents indicated that, depending upon the marine mammal observed, an

average of 10%-31% of their trip costs can be allocated to the observation experience. Also, many individuals indicated that they had observed the animals in the wild at some time in the past. However, travel cost data were collected only for the trips during which marine mammals were observed in 1983. In future studies, more travel cost information could probably be obtained if:

- Respondents were asked to provide travel information for, say, the last five years.
- Survey intent was directed only at travel behavior, which would reduce the length of the survey and time commitment required of respondents in completing the questionnaire.

E. Conclusions

The results of this application of the CVM provide evidence that California households derive significant benefits from publicly provided marine mammal programs. It appears that individuals make some distinctions between the value associated with specific mammals, possibly due to media attention focused on the animals' endangered status. However, while individuals seem able to differentiate between general groups, i.e., whales versus seals, at least some do not make distinctions between species within a mammal group.

Finally, the results in Table 13 have important policy implications. Even when current or future use of the public good (i.e., on-site observation of marine mammals) does not occur, individuals still explicitly stated that more than 50% of program benefits are an existence value. Therefore, even if marine mammals are inaccessible for viewing and impart no regional tourism impacts, societal benefits can still be significantly great to justify protection programs.

REFERENCES

Aizen, I. and M. Fishbein. 1977. Attitude-Behavior Rations: A Theoretical Analysis and Review of Empirical Research. Psychol. Bull. 84:888-918.

Antonelis, G.A., S. Leatherwood and D.K. Odell. 1981. Population Growth and Censuses of the Northern Elephant Seal, Mirounga angustirostris, on the California Channel Islands, 1958-78. Fish. Bull. 79(3):562-567.

Bean, M.J. 1983. The Evolution of National Wildlife Law Praeger, New York, N.Y.

Belsley, D.A., E. Kuh and R.E. Welsch. 1980. Regression Diagnostics John Wiley and Sons, New York, N.Y.

Bishop, R.C. and T.A. Heberlein. 1979. "Measuring Values of Extra-Market Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics 61(5):926-930.

Bohm, P. 1972. "Estimating Demand for Public Goods: An Experiment," European Economic Review 3(2):111-130.

Boyle, K.J., R.C. Bishop and M.P. Walsh, "Starting Point Bias in Contingent Valuation Bidding Games," Land Economics" (forthcoming).

Brookshire, D.S. and T. Crocker. 1981. "The Advantages of Contingent Valuation Methods for Benefit-Cost Analysis," Public Choice 36(2): 235-252.

Brookshire, D.S., L.E. Eubanks and A. Randall. 1983. "Estimating Option Prices and Existence Values for Wildlife Resources," Land Economics 59:1-15.

Brookshire, D.S., B. Ives and W.D. Schulze. 1976. "The Valuation of Aesthetic Preferences," Journal of Environmental Economics and Management 3(4):325-346.

Brookshire, D.S. and A. Randall, 1982: "Public Policy Alternatives, Public Goods, and Contingent Valuation Mechanisms," Western Economics Assocication, Honolulu, HI.

Brookshire, D.S., M.A. Thayer, W.D. Schulze and R.C. d'Arge. 1982. "Valuing Public Goods: A Comparison of Survey and Hedonic Approaches," American Economic Review 72(1):165-177.

Burness, H.S., R.G. Cummings, A.F. Mehr and M.S. Walbert. 1983. "Valuing Policies Which Reduce Environmental Risk," Natural Resources Journal 23(3):675-682.

Carson, R.T. and R.C. Casteline. (Washington D.C.: Resources For the Future). 1984: A Note on Testing and Correcting for Starting Point Bias in Contingent Valuation Surveys. (unpublished manuscript).

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.

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Desvousges, W., V.K. Smith and M. McGivney. 1982. "A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvement," prepared for the U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

Dillman, D.A. 1978. Mail and Telephone Surveys: The Total Design Method New York: Wiley.

Dwyer, J.F., J.R. Kelly and M.D. Bowes. 1977. Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development Urbana-Champaign: University of Illinois.

Fisher, A.C. and M.C. Hanemann. 1984. "Endangered Species and the Economics of Irreversible Damage," American Economics Association Meetings, Dallas.

Freeman III, A.M. 1979. The Benefits of Environmental Improvement: Theory and Practice Baltimore: Johns Hopkins.

Freeman III, A.M. In Press. "On Assessing the State of the Arts of Contingent Valuation Method of Valuing Environmental Goods," In: Valuing Public Goods: An Assessment of the Contingent Valuation Method (Ronald G. Cummings, David S. Brookshire, and William D. Schulze, Eds.), forthcoming.

Gaskin, D.E. 1982. The Ecology of Whales and Dolphins, London: Heinemann.

Gordon, I. and J. Knetsch. 1979. "Consumer's Surplus Measures and the Evaluation of Resources," Land Economics 55(1):1-10.

Goudy, W.J. 1978. "Nonresponse Effects on Relationship Between Variables," Public Opinion Quarterly 40(3):360-369.

Greenley, D.A., R.G. Walsh and R.A. Young. 1981. "Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality," Quarterly Journal of Economics 96:657-673.

_____. 1982. Economic Benefits of Improved Water Quality: Public Perceptions of Option and Preservation Values, Boulder, Colorado: Westview Press.

Grether, D.M. and C.R. Plott. 1979. "Economic Theory of Choice and the Preference Reversal Phenomenon," American Economic Review 69(4):623-638.

Hansen, L.J. 1983. "Population Biology of the Coastal Bottlenose Dolphin, Tursiops truncatus, of Southern California," Master's Thesis, Calif. State Univ.- Sacramento.

Hardin, G. and J. Baden. 1977. Managing the Commons (San Francisco: W.H. Freeman and Company.

Hicks, J.R. 1943. "The Four Consumers' Surplus," Review of Economic Studies 11:31-41.

Hoehn, J.P. and A. Randall. (University of Kentucky) 1983: Contingent Valuation Is A Satisfactory Benefit-Cost Indicator. (unpublished manuscript).

Hovis, J.J., D.L. Coursey and W.D. Schulze. (University of Wyoming) 1983: A Comparison of Alternative Valuation Mechanisms for Non-Market Commodities. (unpublished manuscript).

Huppert, D.D. and C.J. Thomson. 1984. "Demand Analysis of Partyboat Angling in California Using the Travel Cost Method," NMFS Report #LJ-84-06.

Kahneman, D. 1984. "Comments on Valuing Environmental Goods: A State of the Art Assessment of the Valuation Method," R.G. Cummings, D.S. Brookshire and W.D. Schulze (eds), U.S. Environmental Protection Agency Conference, Palo Alto, California.

Kahneman, D. and A. Tversky. 1980. "The Psychology of Preferences," Scientific American 242:160-180.

Karuck, L. and C. Berenson. 1975. "Mail Surveys and Response Rates: A Literature Review," Journal of Market Research 12:440-453.

Kenyon K. No. 68. The Sea Otter in the Eastern Pacific Ocean, Bureau of Sport Fisheries and Wildlife, August 1969. U.S. Government Printing Office, Washington, D.C.

Knetsch, J.L. and J.A. Sinden. 1984. "Willingness to Pay and Compensation Demanded: Experimental Evidence of an Unexpected Disparity in Measures of Value," Quarterly Journal of Economics 99:507-21.

Krutilla, J.V. 1967. "Conservation Reconsidered," American Economic Review 57(4):777-786.

Leatherwood, S.R., R. Reeves, W.F. Perrin, and W.E. Evans. 1982. "Whales, Dolphins, and Porpoises of the Eastern North Pacific and Adjacent Arctic Waters. A guide to their identification. NOAA Tech. Rep. NMFS Circular 444.

Loomis, J.B., G. Peterson and C.F. Sorg. 1984. "Field Guide to Wildlife Analyses," 49th North American Wildlife and Natural Resources Conference, Boston, MA.

Madalla, G.S. 1977. Econometrics, New York: McGraw-Hill.

Maler, K.G. 1974. Environmental Economics: A Theoretical Inquiry Baltimore: Johns Hopkins Press for Resources for the Future, Inc.

Maler,K.G., and R. Wyzgar. 1976. Economic Measurement of Environmental Damage. Paris: Organization for Economic Cooperation and Development.

Marwell, G. and R.E. Ames. 1981. Economists Free Ride: Does Anyone Else? Journal of Public Economics 15(3):295-310.

McConnell, K.E. and I. Strand. 1981. Measuring the Cost of Time in Recreation Demand Analysis: An Application to Sport Fishing. American Journal of Agricultural Economics, 66(5):153-156.

McMillan, J. 1979. The Free-Rider Problem: A Survey, The Economic Record 55:95-107.

Mendelsohn, R.O. 1984. The Benefits of Preserving Endangered Species: With Special Attention to the Humpback Whale. National Marine Fisheries Service Admin. Rep. H-84-14. Honolulu, HI.

Meyer, P. 1980. Recreational/Aesthetic Values Associated with Selected Groupings of Fish and Wildlife in California's Central Valley, Report to the U.S. Fish and Wildlife Service, Sacramento, CA.

Miller, J.R. and M.J. Hay. 1984. Estimating Substate Values of Fish and Wildlife. 49th North American Wildlife and Natural Resources Conference, Boston, MA.

Mitchell, R.C. and R.T. Carson. (Washington, D.C.: Resources for the Future) 1982: Comment on Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality. (unpublished paper).

Morey, E.R. 1981. The Demand for Site-Specific Recreational Activities: A Characteristics Approach. Journal of Environmental Economics and Management 8:345-71.

Randall, A., O. Grunwald, A. Pagoulatos, R. Ausness and S. Johnson. 1978. Reclaiming Coal Surface Mines in Central Appalachia: A Case Study of the Benefits and Costs. Land Economics 54(4):472-89.

Randall, A., B. Ives and C. Eastman. 1974. Bidding Games for Valuation of Aesthetic Environmental Improvements. Journal of Environmental Economics and Management 1:132-49.

Randall, A. and J.R. Stoll. 1974. Consumer's Surplus in Commodity Space. American Economic Review 70:449-454.

Randall, A. and J.R. Stoll. 1983. Existence Valuation in a Total Valuation Framework. In: R. Rowe and L. Chestnut (eds.), Managing Air Quality and Scenic Resources at National Parks and Wilderness Areas, Westview Press: Boulder, Colorado.

Ravenscraft, D.J. and J.F. Dwyer. 1978. Reflecting Site Attractiveness in Travel Cost-Based Models for Recreation Benefit Estimation," Forestry Research Report 78-6, Department of Forestry, University of Illinois, Urbana.

Reilly, S.B. (University of Washington, Seattle) 1981: Population Assessment and Population Dynamics of the California Gray Whale, Eschrichtiun robustus. Ph.D. Dissertation.

Rowe, R.D., R.C. d'Arge and D.S. Brookshire. 1980. An Experiment on the Economic Value of Visibility. Journal of Environmental Economics and Management 7(1):1-19.

Samuelson, P.A. 1954. The Pure Theory of Public Expenditure. Review of Economics and Statistics 36:387-389.

Schulze, W., D. Brookshire , E. Walther, K. Kelley, M. Thayer, R. Whitworth, S. Ben-David, W. Malm, and J. Molener. 1981. Benefits of Preserving Visibility in the National Parklands of the Southwest, Volume VIII, Methods Development for Environmental Control Benefits Assessment, U.S. Environmental Protection Agency.

Schulze, W.D., R.G. Cummings, D.S. Brookshire, M.A. Thayer, R. Whitworth, and M. Rahmatian. 1983. Experimental Approaches for Valuing Environmental Commodities, Methods Development in Measuring Benefits-of Environmental Improvements, U.S. Environmental Protection Agency.

Schulze, W.D., R.C. d'Arge and D.S. Brookshire. 1981. Valuing Environmental Commodities: Some Recent Experiments. Land Economics 57(2):151-172.

Sellar, C., J.R. Stoll and J.P. Chavas. 1984. Validation of Empirical Measures of Welfare Change: A Comparison of Non-market Techniques. Land Economics, 61(2):156-75.

Smith, V.L. 1977. The Principle of Unanimity and Voluntary Consent in Social Choice. Journal of Political Economy 85(6):1125-1139.

Stoll, J.R. and L.A. Johnson. 1984. Nonmarket Values of the Whooping Crane. 49th North American Wildlife and Natural Resources Conference Boston, MA.

Thayer, M.A. 1981. Contingent Valuation Techniques for Assessing Environmental Impacts: Further Evidence. Journal of Environmental Economics and Management, 8:27-44.

Thompson, M.E. and K.J. Roberts. Forthcoming. An Empirical Application of the Contingent Valuation Technique to Value Marine Resources. Transactions of the American Fisheries Society,(forthcoming).

U.S. Fish and Wildlife Service. 1981. The Southern Sea Otter Recovery Plan.

Walsh, R.G., J.B. Loomis and R.A. Gilman. 1984. Valuing Option, Existence, and Bequest Demands for Wilderness. Land Economics 60(1): 14-29.

Wellman, J.D., E.G. Hawk, J.W. Roggenbuck, and G.J. Buhyoff. 1980. Mailed Questionnaire Surveys and the Reluctant Respondent: An Empirical Examination of Differences Between Early and Late Respondents. Journal of Leisure Research 12(2):164-173.

Willig, R.D. 1976. Consumer's Surplus Without Apology. American Economic Review 66(5):89-97.

Wilman, E.A. 1984. Benefits of Forest Management Practices to Deer Habitat. 49th North American Wildlife and Natural Resources Conference, Boston MA.

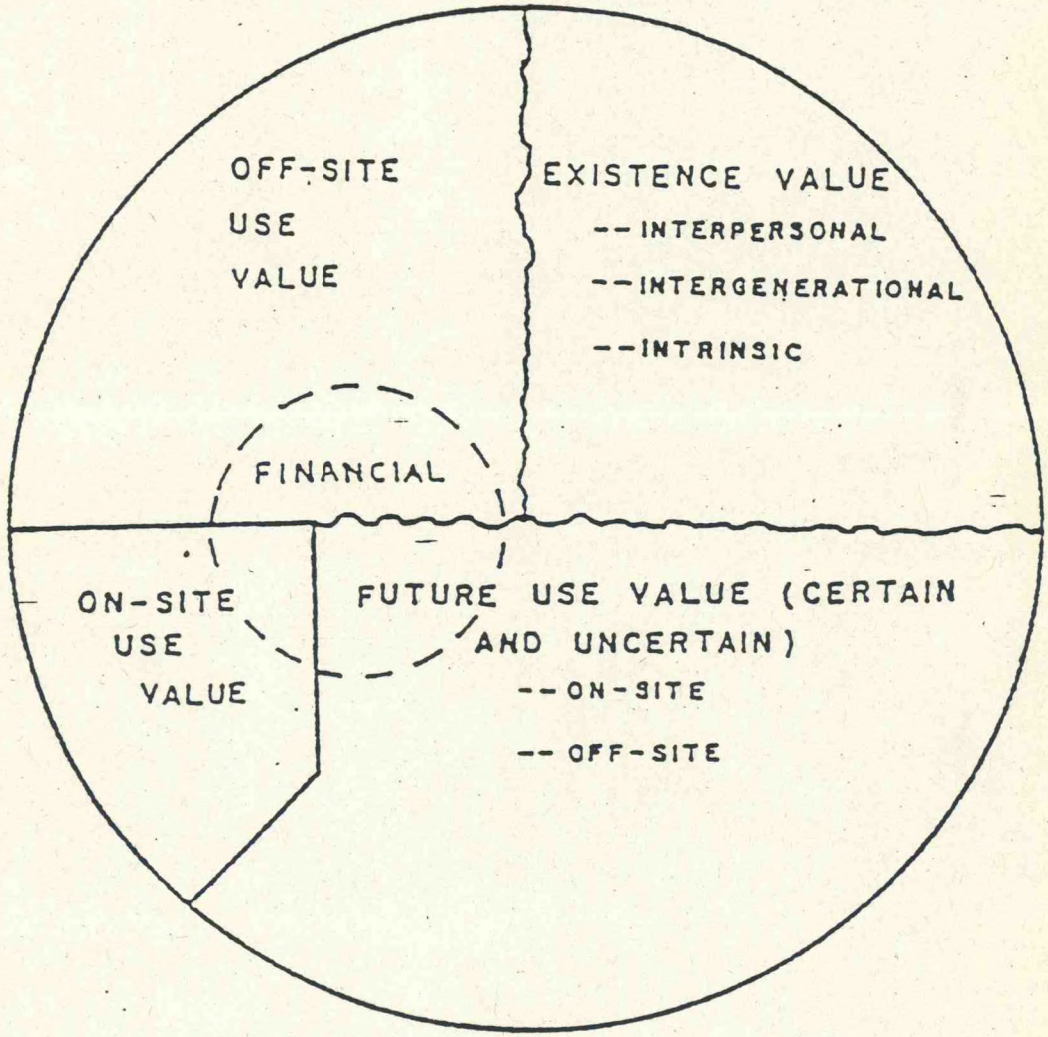

Figure 1. Total value framework.
(from Randall and Stoll, 1983)

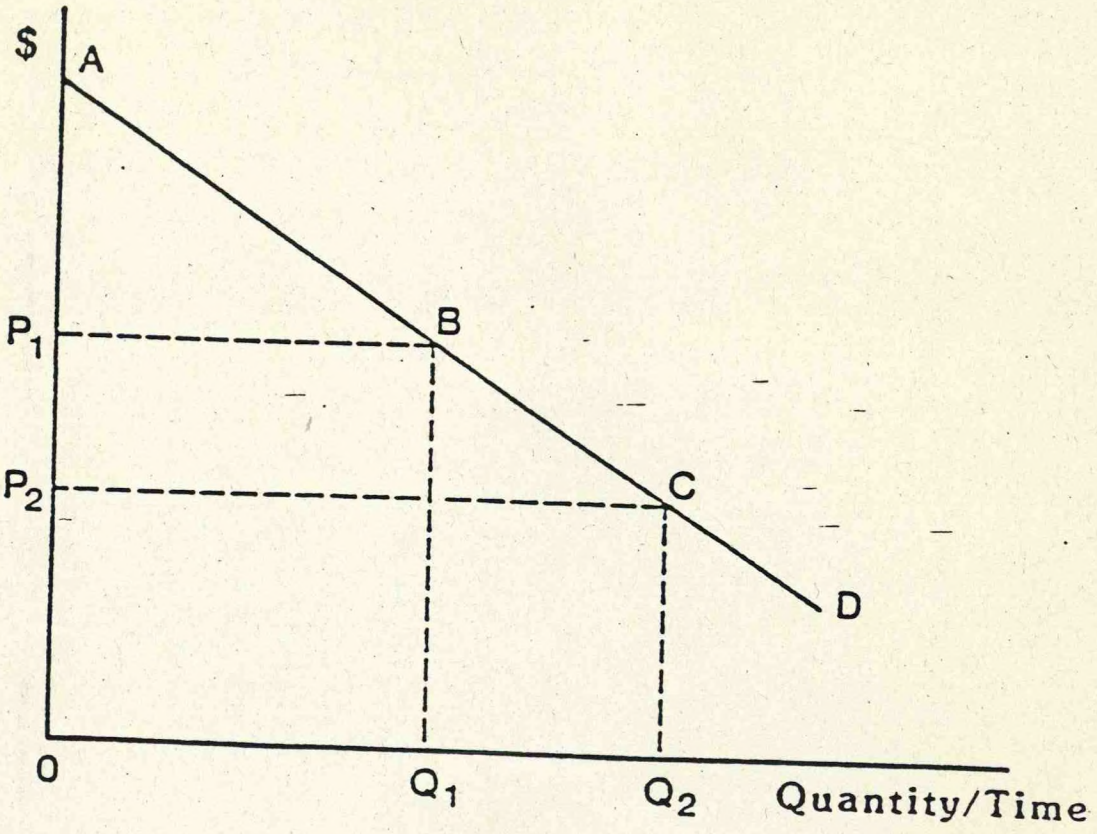

Figure 2. Demand curve.

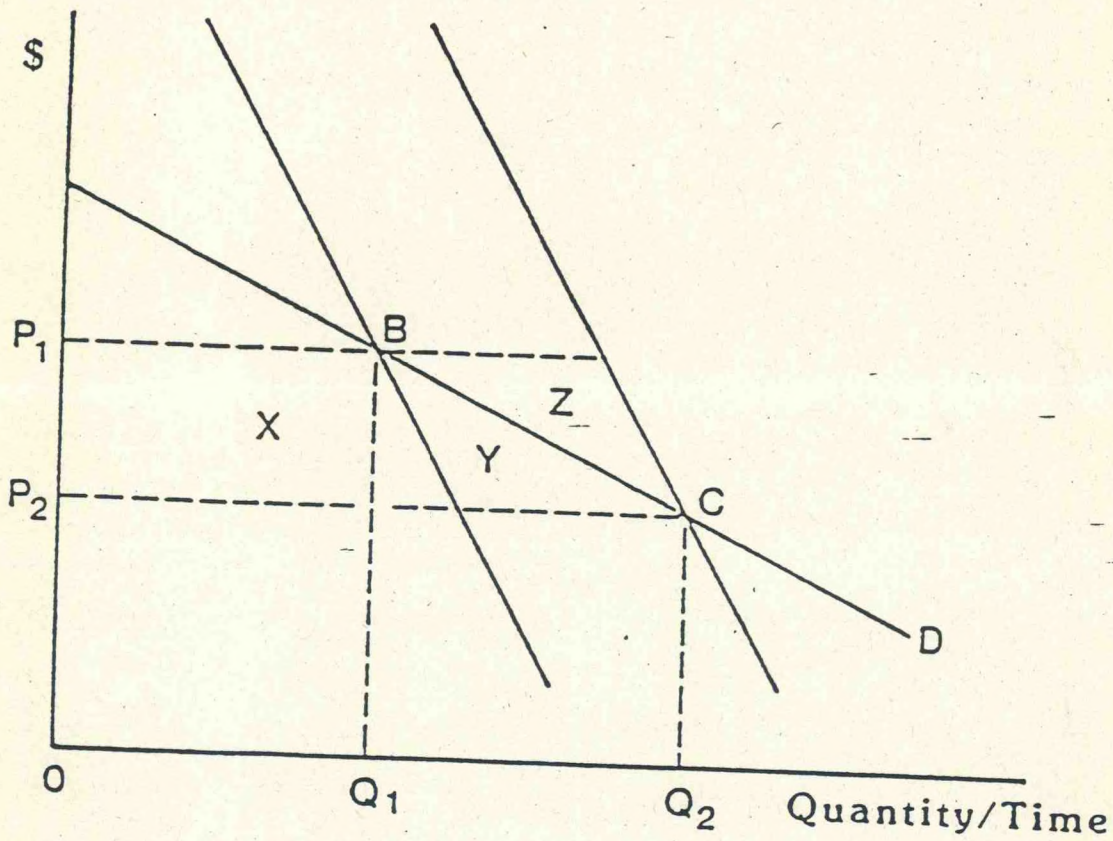

Figure 3. Compensated demand curves.

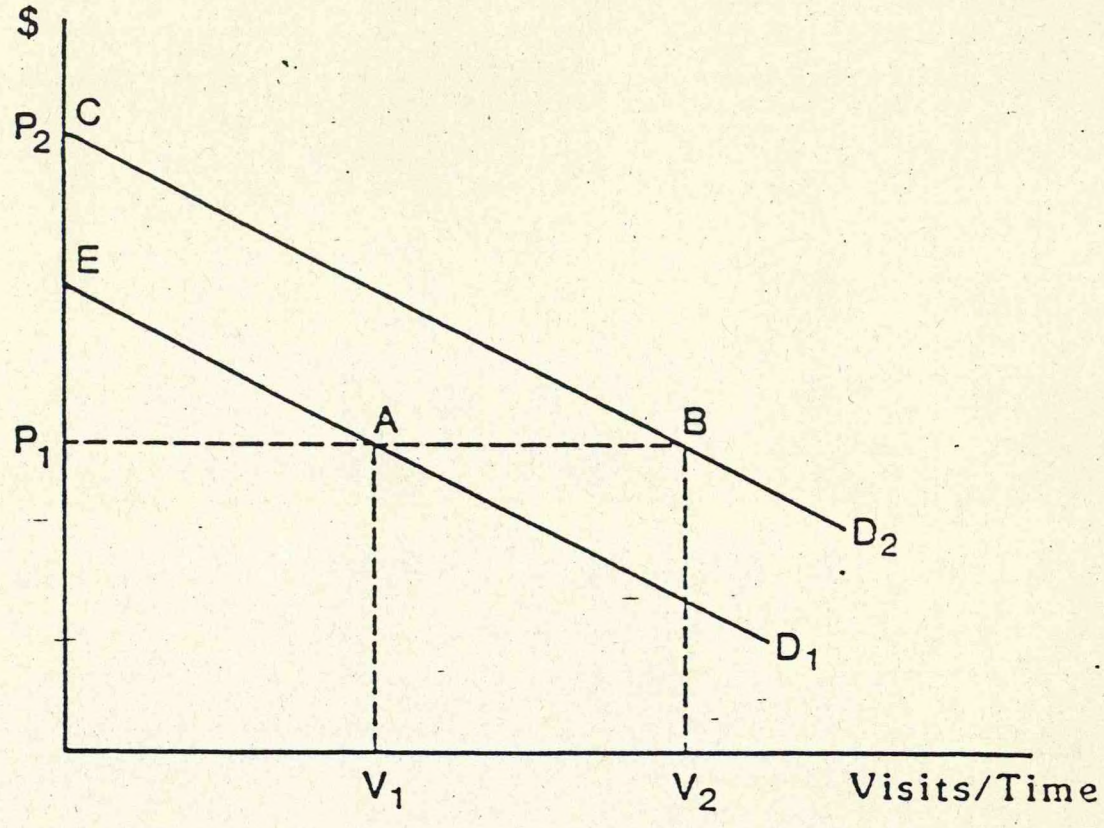

Figure 4. Demand for environmental quality.

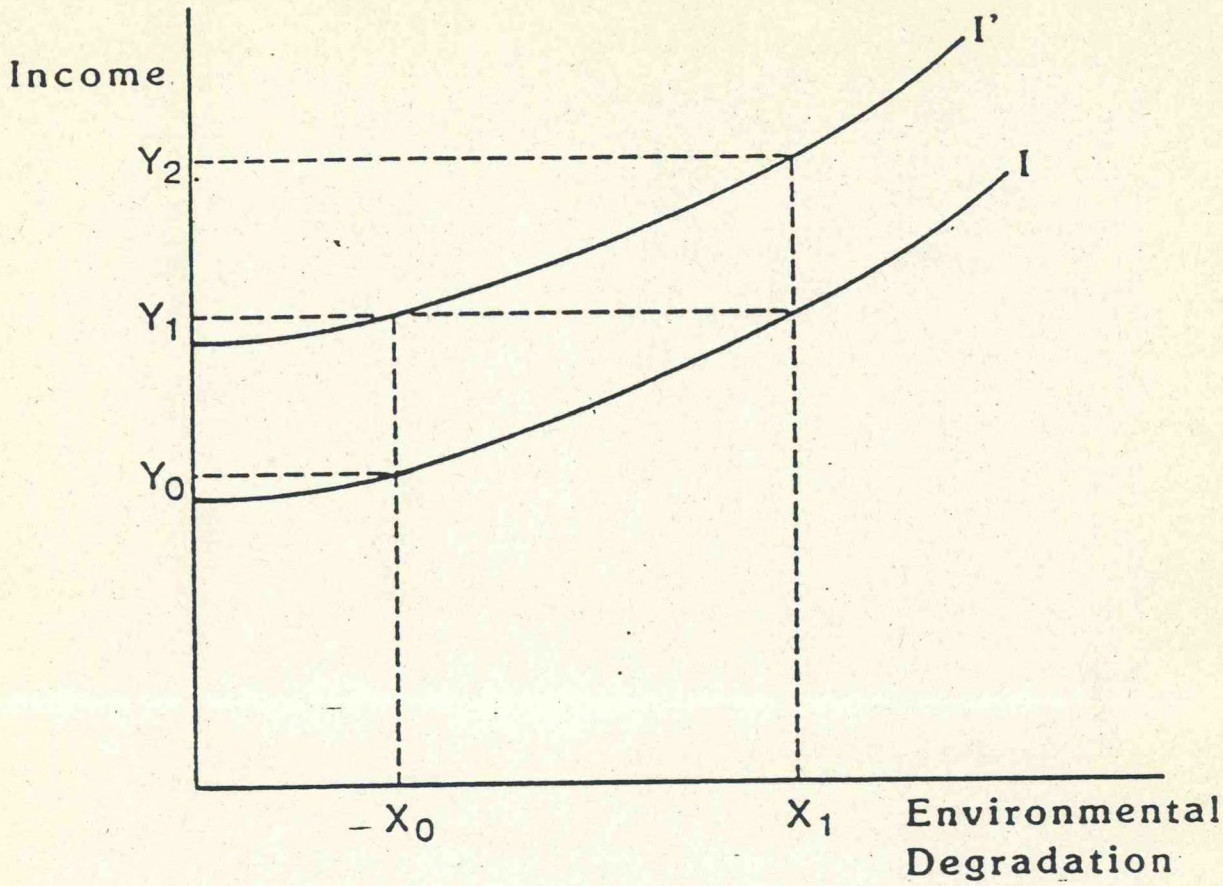

Figure 5. Comparison between willingness-to-pay and willingness-to-accept for changes in environmental quality.

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)

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 eviation	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

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).

Table 3. INITIAL BID[a]

	Whales Gray and Blue	Bottlenosed 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.)

Table 4. ADJUSTMENTS TO BID[a]

	Whales (Gray and Blue)		Bottlenosed 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).

Table 5A: 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

Table 5C: CORRELATION MATRIX, CALIFORNIA SEA OTTERS

	WTP	EXP	Miles	Fam.Sz	Age	Sex	Income	Educ.	Hunt/fish	Env.Org.	AVM1
WTP	1.										
EXP	.15	1.									
Miles	-.05	.02	1.								
Fam. Sz.	-.09	.15	.00	1.							
Age	-.13	.05	.01	-.16	1.						
Sex	.02	.05	.08	.00	.07	1.					
Income	.04	.04	-.06	.13	.11	-.11	1.				
Education	.14	.05	-.09	-.11	.16	-.18	.22	1.			
Hunt/fish	-.01	-.04	.15	.25	.21	-.01	-.10	.02	1.		
Env. Org.	.09	.12	.06	-.23	-.31	-.06	.21	.37	.02	1.	
AVM1	.13	.03	-.12	.05	.32	-.03	-.02	.08	.37	.03	1.
AVM2	.24	.05	.04	-.06	.04	.01	-.19	.14	-.05	.33	.38

Table 5B: CORRELATION MATRIX, BOTTLENOSE DOLPHINS

	WTP	EXP	Miles	Fam.Sz	Age	Sex	Income	Educ.	Hunt/fish	Env.Org.	AVM1
WTP	1.										
EXP	.18	1.									
Miles	-.05	-.05	1.								
Fam. Sz.	-.07	.03	-.01	1.							
Age	.13	-.01	.02	-.16	1.						
Sex	.04	-.04	.07	.00	.07	1.					
Income	.05	-.00	-.06	.12	.10	-.09	1.				
Education	.14	.09	-.09	-.11	.16	-.19	.21	1.			
Hunt/fish	-.01	-.04	.15	.25	.21	-.01	-.10	-.22	1.		
Env. Org.	.09	.12	.06	-.23	-.31	-.06	.03	.21	.02	1.	
AVM1	.13	.21	-.12	.05	.32	-.04	-.02	.08	.37	.03	1.
AVM2	.23	.27	.04	-.06	.04	.01	-.18	.14	-.05	.33	.38

Table 5D: CORRELATION MATRIX, NORTHERN ELEPHANT SEALS

	WTP	EXP	Miles	Fam.Sz	Age	Sex	Income	Educ.	Hunt/fish	Env.Org.	AVM1
WTP	1.										
EXP	.21	1.									
Miles	-.03	-.06	1.								
Fam. Sz.	-.07	-.13	-.03	1.							
Age	-.13	.00	.21	-.17	1.						
Sex	.04	.02	.05	.01	.07	1.					
Income	.03	.00	-.05	.13	.11	-.11	1.				
Education	.15	.24	-.17	-.11	.16	-.08	.68	1.			
Hunt/fish	-.01	-.04	.15	.25	.21	-.01	-.10	.02	1.		
Env. Org.	.09	.12	.06	-.23	-.31	.06	.21	.37	.02	1.	
AVM1	.10	-.05	-.05	.05	.32	-.03	-.02	.08	.37	.03	1.
AVM2	.23	.14	.04	-.05	.04	.01	-.19	.14	-.05	.33	.38

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 Otters		Northern Elephant Seals	
	All Data	Without Outliers	All Data	Without Outliers	All Data	Without Outliers	All Data	Without Outliers
Constant	4.89	.98	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	.08	.08

*Significant at the 95% level, $t \geq 1.645$.

Table 7. RESPONSES OF LIKELY OUTLIERS

Responses	OUTLIER 1				OUTLIER 2				OUTLIER 3[a]			
	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 data sets only.

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

Variables	Whales	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals	Standard Deviati (Weighted Averag
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	2.6	

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

	Whales (Gray and Blue)	Bottlenose Dolphins	California Sea Otters	Northern Elephant Seals
Mean	$23.95 ($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] Q 11± Q14A
[b] For comparison, values for all respondents, including likely outliers, are shown in parentheses.
[c] The null hyposthesis is WTP>0; reject if t≥2.326 (99% confidence).

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

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

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

Table 12A. OBSERVER AND TRAVEL DATA, WHALES (30 RESPONDENTS OUT OF 180)

Respondents' Location	Number of trips (1983)	Miles Traveled (car, boat)	Number of people/trip	Share of trip cost (per cent)[a]
Los Angeles	1	75,n.a[b]	4	60
Costa Mesa	1	110,00	n.a.	n.a.
Alhambra	1	25,10	65	20
Torrance	2	5,3	2	0
W. Los Angeles	3	10,0	2	60
Lemon Grove	1	20,10	5	0
Spring Valley	2	18,0	3	5
San Diego	1	0,1	25	5
San Jose	1	1500,0	1	5
La Mirada	4	45,10	6	95
San Jose	1	50,10	25	60
Oakland	1	160,0	2	20
El Cajon	1	15,5	1	5
Atascadero	1	15,5	1	5
Santa Monica	1	10,0	12	60
N. Hollywood	3	8,5	30	60
San Francisco	1	20,20	10	5
Long Beach	2	12,3	3	5
Oildale	1	100,15	3	20
Bellflower	1	45,10	4	60
Torrance	1	50,25	n.a.	60
Santa Cruz	2	75,20	4	20
South Gate	1	60,30	8	60
El Cajon	1	30,0	8	60
Fair Oaks	1	200,20	8	60
San Jose	2	40,0	4	0
San Francisco	1	30,0	2	5
Bellflower	3	40,24	2	60
Gualala	28	15,0	3	5
Oakview	1	10,0	n.a.	20
Total	71	2793,226	243	
sample mean	2.4	93.1,7.79	9	.31
sample std. dev.	4.9	269.7,9.02	12.9	.28

[a] Percentages shown are the mean values of respondents' choices for question 8: A=0%, B=1-9%, C=10-30%, D=40-80%, E=95-100%.

[b] An "n.a." in a column means "no answer" was given; the mean of the column was used in the calculation of the sample mean.

Table 12B. OBSERVER AND TRAVEL DATA, BOTTLENOSE DOLPHINS (30 RESPONDENTS OUT OF 175)

Respondents' Location	Number of trips (1983)	Miles Traveled (car, boat)	Number of people/trip	Share of trip cost (per cent)[a]
Los Angeles	1	75,n.a[b]	4	60
Alhambra	1	25,10	65	20
Torrance	4	5,2	2	0
San Diego	2	100,10	20	20
La Mirada	many	45,2	2-10	95
Oakland	1	110,0	2	20
Santa Monica	20	125,0	4	n.a.
San Francisco	2	0,20	40	5
Downey	1	0,1/4	8	0
El Cajon	4	18,3	3-4	0
Alhambra	2	50,0	2	0
Santa Monica	2	10,0	5	20
Torrance	1	1/2,20	35	0
Glendale	2	35,0	3	0
La Crescenta	4	4,5	6	5
San Gabriel	2	3,0	1	20
San Diego	1	1/4,0	3	5
Los Angleles	1	20,0	2	20
Rialto	1	500,5	10	5
Long Beach	20	12,0	1	n.a.
Oildale	1	100,0	4	20
South Gate	1	150,0	4	0
El Cajon	1	30,0	6	20
Los Angeles	3	20,0	2	0
Bellflower	3	20,15	1	20
Culver City	2	5,5	2	20
Vallecito	1	250,1	5	20
Oak View	1	10,0	n.a.	20
Westwood	3	30,0	3	0
Covina	1	25,0	2	0
TOTAL	89+	1777.75,98.25	247+	
sample mean	3.3	59.26,3.39	8.67	.15
sample std. dev.	4.9	100.64,5.82	14.05	.197

[a] Percentages shown are the mean values of respondents' choices for question 8: A=0%, B=1-9%, C=10-30%, D=40-80%, E=95-100%.

[b] An "n.a." in a column means "no answer" was given; the mean of the column was used in the calculation of the sample mean.

Table 12C. OBSERVER AND TRAVEL DATA, CALIFORNIA SEA OTTERS

Respondents' Location	Number of trips (1983)	Miles Traveled (car, boat)	Number of people/trip	Share of trip cost (per cent)[a]
San Francisco	2	80,0	2	5
Carson	1	30,0	5	5
Alamo	1	220,0	4	20
Whiskeytown	1	200,0	3	5
W. Los Angeles	20	15,0	2	60
San Diego	1	600,10	10	5
Los Angeles	2	4,25	4	5
San Jose	1	1500,0	1	5
San Jose	10	50,0	3	0
Gardena	2	20,22	4	0
Oakland	2	160,0	2	20
Atascadero	1	15,0	4	0
San Francisco	2	200,0	2	95
El Cajon	1	280,0	3	5
Alhambra	1	50,0	2	0
Atascadero	6-8	20,0	2-5	5
San Jose	2	25,0	1	0
Glendale	1	400,0	1	0
Orinda	3	120,0	2	5
San Francisco	1	50,0	2	60
Sunnyvale	2	80,0	2	5
Forestville	2	n.a.,0	4	5
Rialto	1	500,0	2	5
Long Beach	1	11,0	1	5
Oildale	1	100,0	4	20
Bellflower	1	150,0	6	20
Torrance	1	150,0	n.a.[b]	20
Santa Cruz	1	100,0	5	20
South Gate	1	200,0	4	20
El Cajon	1	250,0	5	20
Fair Oaks	1	100,0	6	60
San Francisco	5	60,0	2	60
Buena Park	2	200,0	2	5
San Francisco	2	50,0	5	0
Bellflower	1	600,0	2	95
Mountain View	1	50,0	2	5
Oak View	1	10,2	n.a.	20
Westwood	3	30,0	3	0
Three Rivers	1	150,0	2	0
Whitter	4	50,0	2	5
Menlo Park	2	60,0	6	20
Rancho Cordova	1	100,0	8	n.a.
Van Nuys	1	75,0	n.a.	5
Saratoga	2	50,0	4	20
Sacramento	1	200,0	4	60
Traver	1	150,0	4	60
TOTAL	90+	7515,59	140+	

Table 12C. OBSERVER AND TRAVEL DATA, CALIFORNIA SEA OTTERS (continued)

Sample mean	2.24	167,1.28	3.38	.19
Sample std. dev.	3.17	246.4,5.03	1.84	.25

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a/Percentages shown are the mean values of respondents' choices for question 8: A=0%, B=1-9%, C=10-30%, D=40-80%, E=95-100%.

b/An "n.a." in a column means "no answer" was given; the mean of the column was used in the calculation of the sample mean.

Table 12D. OBSERVER AND TRAVEL DATA, NORTHERN ELEPHANT SEALS (19 RESPONDENTS OUT OF 174).

Respondents' Location	Number of trips (1983)	Miles Traveled (car, boat)	Number of people/trip	Share of trip cost (per cent)[a]
San Francisco	1	90,4	4	20
Whiskey Town	1	200,0	3	5
San Diego	2	200,15	10	5
E. Palo Alto	2	45,0	5	20
Oakland	1	110,0	2	20
Los Angeles	2	100,2	n.a.[b]	5
Orinda	5+	85,0	2	0
Long Beach	2	15,0	1	5
San Francisco	3	60,0	2	60
San Francisco	15	30,0	3	5
Los Angeles	4	20,0	2	0
Oakland	2	30,0	n.a.	0
Orangevale	2	91,0	3	20
Mountain View	1	50,0	2	5
Oak View	1	10,0	n.a.	20
Westwood	10	30,0	2	0
San Francisco	1	50,0	2	5
Three Rivers	1	200,0	2	0
Whittier	4	50,0	2	5
TOTAL	60+	1466,21	47	
sample mean	3.15	77.16,1.11	2.94	.10
sample std. dev.	3.59	61.98,3.51	1.93	.145

[a] Percentages shown are the mean values of respondents' choices for question 8: A=0%, B=1-9%, C=10-30%, D=40-80%, E=95-100%.

[b] An "n.a." in a column means "no answer" was given; the mean of the column was used in the calculation of the sample mean.

Table 13. 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.