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# THE VALUE OF THE PUSCH RIDGE BIGHORN SHEEP HERD

by

Deborah Jo Bugarsky

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A Thesis Submitted to the Faculty of the

SCHOOL OF RENEWABLE NATURAL RESOURCES

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE
WITH A MAJOR IN RENEWABLE NATURAL RESOURCES STUDIES

In the Graduate College

THE UNIVERSITY OF ARIZONA

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ABSTRACT

The juxtaposition of a herd of desert bighorn sheep and the Tucson metropolitan area presents natural resource decision makers with a unique management situation. The goal of this study was to provide valuable information on the herd which would be useful to decision makers.

The nature of the problem dictated the use of the contingent valuation method to estimate the total and existence values of the herd. Tucson residents were surveyed using a mail questionnaire. Respondents were questioned on the motive underlying their value for the herd.

The total value of the herd to Tucsonans was found to lie between $2,248,220 and $4,031,328 per year, of which 90 percent is existence value. Intrinsic altruism was an important motive underlying the value of the herd among both users and nonusers of the herd. Bid function for total value and existence value indicated that household income, a desire for the opportunity to see sheep in the future, and education were positively related to the respondent's bid.

Existence value of the herd may be useful in determining the intensity of use of the Pusch Ridge area. The usefulness of results to decision makers and their implications for management and policy are discussed.

# CHAPTER 1

# INTRODUCTION

A herd of 70 to 100 desert bighorn sheep reside in the Pusch Ridge Wilderness Area, located in the Santa Catalina Mountains. The habitat includes about 13 square miles and is situated approximately nine miles north of downtown Tucson, Arizona. The Pusch Ridge Wilderness (PRWA) was designated in 1978 under the Endangered American Wilderness Act, with the bighorn sheep herd being a significant consideration in designation (Krausman, Shaw, and Stair 1979).

## The Problem

The current population of 70 to 100 bighorns in the Pusch Ridge area is well below the estimated 220 sheep reported in 1928. A large increase in recreational use of the Pusch Ridge area is one possible cause for this reduction in population. Several trails in the wilderness provide access to the bighorn habitat. The three most heavily used trails, Pima Canyon, Finger Rock Canyon, and Romero Canyon trails, received an estimated 34,000 visitors in 1980 (Purdy and Shaw 1981). Because the trailheads are only a 10 to 30 minute drive away for most Tucson residents, the areas served by them receive heavy recreational use.

Intensive development of adjacent land may also be causing sheep numbers to decline. Residential development is taking place adjacent to the wilderness boundary, resulting in disturbances as close as one quarter mile to prime bighorn habitat (Gionfriddo 1984). Development around the Pusch Ridge area causes isolation of the herd from other herds, thus, weakening its gene pool and making it vulnerable to disease. Excessive fire suppression, which allows establishment of vegetation undesirable for bighorns, may also be contributing to the decline in sheep numbers (Anon. 1985).

In response to the decreasing herd size, the Coronado National Forest, Arizona Department of Game and Fish, and The University of Arizona School of Renewable Natural Resources initiated an interagency Pusch Ridge bighorn sheep management plan in May 1985. As stated in the interagency memorandum, the short-term goal outlined for the plan is to "maintain the existing suitable habitat in order to at least sustain the current population". The long-term goal seeks "to improve the quality of the existing habitat and increase the area of suitable habitat as a means to improve both the health of the herd and increase the overall numbers to 150-200 animals" (Anon. 1985). Action is already being taken to improve habitat quality using prescribed fire in areas adjacent to the PRWA and by minimizing dog / desert bighorn sheep confrontations. The plan also calls for

research and information on various aspects of the sheep population.

The juxtaposition of big game habitat with a growing metropolitan area presents local, state, and federal agencies with difficult decisions regarding the intensity of urban development adjacent to, and the intensity of recreational use within, the PRWA. These decisions involve allocating limited land resources among beneficial and conflicting uses. In weighing the merits of the conflicting uses, knowledge about the economic values of the herd to Tucsonans would be most useful. The problem addressed in this research is: what are the economic values of the Pusch Ridge bighorn sheep herd to Tucsonans and what factors influence those values?

In this paper I present and discuss the concepts of wildlife value in the context of benefit-cost analysis and land allocation decisions. This is followed by the results of an empirical study used to test the concepts and to estimate the value of the Pusch Ridge bighorn sheep herd to Tucsonans.

## Concepts of Wildlife Value

The total value of wildlife, the appropriate value concept for benefit-cost analysis (Boyle and Bishop 1985), is the sum of use values and existence value (McConnell 1983). The various components of total value are shown in

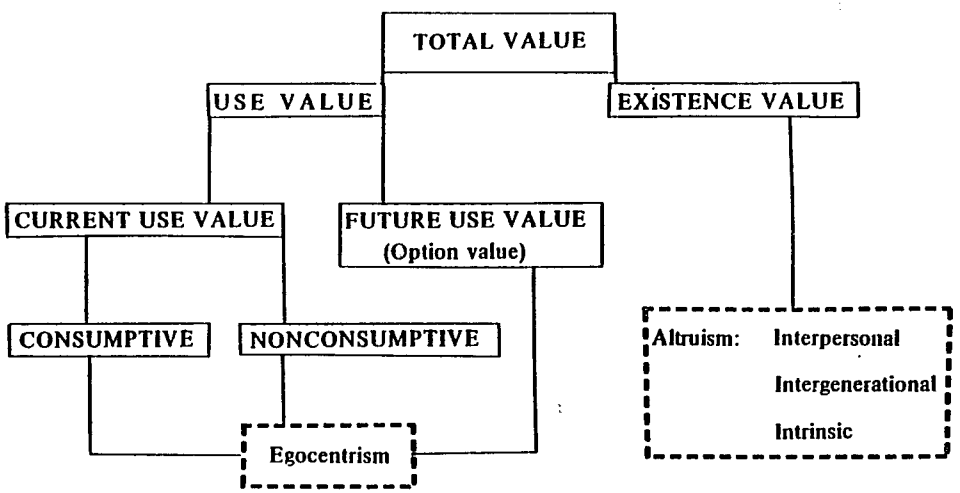


Figure 1. Wildlife Values and Motives Based on Randall and Stoll (1983)

Figure 1. Use values include consumptive use value, nonconsumptive use value, and future use value, also called option value, all of which are motivated by egocentrism. Existence value is motivated by altruism and is unrelated to use of the resource (Randall and Stoll 1983). Conceptually, each component of total value has a different source, however, empirical attempts to estimate them separately have had little success (Brookshire, Eubanks, and Randall 1983; Walsh, Loomis, and Gillman 1984; Stoll and Johnson 1985).

## Use Values

Use values for wildlife arise when individuals or society benefit from the use of the species or its habitat. Consumptive use value of wildlife is the benefit one gains from hunting a species. Nonconsumptive use value accrues from nondestructive uses of the species such as viewing or photographing wildlife.

The current use value of wildlife may be estimated with direct or indirect methods. Indirect methods, such as the travel cost model (Clawson and Knetch 1966), can be employed because of weak complementarity between uses of wildlife and market goods, such as travel costs. Here willingness to pay for consumptive and nonconsumptive uses of wildlife are inferred (indirectly) from users' travel costs to the site. Use value of wildlife may also be estimated directly by asking the user how much they would be

willing to pay to hunt, view, or photograph a species. This approach is called the contingent valuation method (CVM) (Randall, Ives and Eastman 1974).

Future use value or option value is the amount of money a person would be willing to pay, above their expected consumer surplus, for the option to use the resource in the future (Weisbrod 1964). For example, the amount individuals are willing to pay for insurance policies represents option value for some goods. In most natural resource cases, option value is unrelated to consumer behavior and cannot be estimated using inferential methods such as the travel cost model or the hedonic approach. Option value, therefore, must be estimated directly using the CVM. When option value is etimated empirically using the CVM, the result is option price, which is the sum of option value and expected consumer surplus (Bishop 1982).

Under conditions of demand and supply uncertainty, Schmalensee (1972) concluded that option value may be positive or negative and, therefore, should be assumed to equal zero in applied studies. He went on to suggest that expected consumer surplus be used as an estimate of future use benefits. Bishop (1982) points out that in most natural resource decisions, demand is certain, but future availability of the resource is in doubt, implying that option value is positive and possibly quite significant.

Hence, an underestimate of total value will result if option value is ignored.

Existence Value

Existence value, as introduced by Krutilla (1967), is the satisfaction an individual gains by simply knowing a resource exists, unrelated to any future plans to use the resource. Individuals have demonstrated their existence value for wildlife by contributing to organizations whose purpose is to preserve a species, which they may never see. The establishment of policies that protect endangered and threatened species indicate that society recognizes the existence and option values of wildlife.

Randall and Stoll (1983) have conceptualized existence value as arising from three categories of altruism: 1) Intergenerational, in which knowledge that future generations will benefit from the resource provides satisfaction to an individual (includes bequest value); 2) Interpersonal, in which making the resource available to contemporaries provides satisfaction to individuals, and 3) Intrinsic altruism, in which the resource has value in and of itself (Figure 1).

Some researchers claim that irreversibility and uniqueness are necessary conditions for existence value (Krutilla 1967) (Weisbrod 1964). However, Schulze, Brookshire et. al. (1983), have shown that irreversibility

is not a necessary condition. Their empirical results indicate that visibility at the Grand Canyon has a substantial existence value, yet poor visibilty is not an irreversible state. Wildlife species, on the other hand, may not be regenerated once extinct.

Randall and Stoll (1983) illustrate that uniqueness is not a necessary condition for existence value by comparing the California condor and cattle. They argue that, because cattle are so widespread and important to so many cultures, their total elimination would result in a greater existence loss than the elimination of all condors. Thus, uniqueness is not a necessary condition for existence value. The authors go on to point out that, since there are so few California condors left in the wild, the marginal existence value of condors is probably higher than the marginal existence value of cattle. This comparison supports the theory that uniqueness contributes to existence value at the margin. When estimating the total value of a local wildlife population, however, the relevant concept is marginal existence value, for which uniqueness is a necessary condition.

## Estimating Existence Value

The characteristics of existence value limit how it can be estimated. Because existence value is motivated by altruism and is unrelated to use of the resource, it cannot

be linked to economic behavior. Thus, lack of weak complementarity eliminates inferential methods for estimating existence value (Boyle and Bishop 1985). Consequently, the contingent valuation method is the only technique presently available to estimate existence value (Rae 1983; Madariaga and McConnell 1985; Rowe and Chestnut 1982).

Although total value is the appropriate estimate for benefit-cost analysis, estimates of existence value are useful in addressing questions regarding desirable intensity of use (consumptive or nonconsumptive) of a wildlife resource. Further, a separate estimate of existence value is of interest for studying the motives underlying the value expressions of individuals.

In a study to estimate the value of grizzly bear and bighorn sheep to Wyoming hunters, Brookshire, Eubanks, and Randall (1983) report separate estimates of option, existence and use value for each species, based on whether the respondent plans to hunt or observe the species. Existence value was recorded for those respondents who did not plan to do either. Stoll and Johnson (1985) use a similar approach to estimate option and existence value for whooping cranes to United States citizens. Bids from respondents who did not anticipate visiting the whooping crane's habitat were recorded as existence value, and for those who did anticipate visiting, as option value. This

approach for estimating existence value assumes that users of the resource have only option or use value, and no existence value for the resource.

Loomis (1985) found that consumptive users of wildlife often hold high existence value for big game species. Boyle and Bishop (1985) estimate existence value for bald eagles in Wisconsin by presenting the respondent with a scenario in which bald eagles would not be available for viewing, and then ask them their willingness to pay to preserve them. This method for estimating existence value is conceptually appealling since it allows both users and nonusers to express existence value for the resource.

## Values of the Pusch Ridge Bighorn Sheep

To summarize this review of values, it seems appropriate to discuss how they apply to the Pusch Ridge bighorn sheep herd. Consumptive use value of the Pusch Ridge bighorns may be quite substantial, but to only a few individuals and not necessarily residents of Tucson or of Arizona. One or two individuals each year obtain a permit, allocated by a lottery, to hunt bighorn sheep on Pusch Ridge. The probability is small that a resident of Tucson will obtain a permit to hunt and benefit from this use of the herd.

Each year, hunting bighorn sheep on Pusch Ridge renews a controversy about whether or not this use of the

herd is appropriate. This controversy, recognized by letters to the editor, is most likely a result of public awareness of and concern for the Pusch Ridge herd. This reaction indicates that hunting of the herd has negative value to some individuals and complicates any estimation of consumptive use value. The above discussion implies that net consumptive use value of the Pusch Ridge herd is probably a small portion of its total value to residents of Tucson. For this reason, consumptive use value was not estimated in this study.

According to a 1980 survey of visitors to the Pusch Ridge Wilderness Area (PRWA), nonconsumptive use of the herd at that time was minimal as well (Purdy and Shaw 1981). Sightings of bighorns were rare events, occurring for only one percent of the visitors on their last trip into the habitat area and only seven percent on any previous trips. Of those who saw sheep, 60 percent indicated the event as the highlight of their trip. None of the visitors sampled indicated that a primary reason for their visits to the area was to see sheep. Although visitors who saw bighorn sheep in the PRWA claim it as a valuable experience, the small percentage of visitors who actually saw sheep implies that nonconsumptive use value contributed little to the total value of the herd. A low option value is also implied since visitors did not go to the PRWA primarily to see bighorns.

The 1980 survey conducted by Purdy and Shaw gathered information from 84 visitors on their attitudes toward the bighorn sheep population. When given a hypothetical situation of a declining sheep population in the PRWA and alternative management strategies, the majority of the visitors favored mandatory use restrictions. The least favored alternative, given this situation, was no change in current policy. Although users of the PRWA seldom experienced direct encounters with desert bighorn sheep, the value of the bighorns was indicated by the respondents' expressed willingness to comply with mandatory use restrictions in critical habitat areas (Purdy and Shaw 1981).

Within the past year, public reactions on hunting the sheep and media coverage of potential user restrictions in the PRWA, indicate that there may be increased public awareness and concern for the Pusch Ridge herd. These characteristics indicate that the value of the herd may have increased since 1980.

The information on use of the Pusch Ridge herd implies that the herd does have value and that existence value is a large proportion of its total value. The herd's characteristics and public reactions to hunting the herd, provide further support for this hypothesis. Although bighorn sheep are not endangered in Arizona, they are not abundant, which causes them to have a greater marginal

existence value than more common species. Further, the close proximity of the Pusch Ridge herd to Tucson, makes it unique on a local level. The controversy that develops on hunting the bighorns indicates existence value for them, and further implies that the existence value is motivated by intrinsic altruism towards the sheep themselves rather than altruism towards society or the users of the herd.

The discussion above leads to two general hypotheses: 1) existence value is a major proportion of the total value of the herd; and 2) intrinsic altruism is the most important motive underlying the existence value of the herd.

## Objectives

The objectives of the study were to:

1. Estimate the total value and existence value of the Pusch Ridge bighorn sheep herd to residents of the Tucson urban area.

2. Estimate the effects of socioeconomic and other taste and preference variables on the total value and existence value of the Pusch Ridge bighorn sheep herd.

3. Determine the motives underlying the value of the Pusch Ridge bighorn sheep herd to Tucsonans.

# CHAPTER 2

# METHODS

## The Contingent Valuation Method

The general problem presented in this study is one of nonmarket resource valuation and the characteristics of the resource determine which valuation technique is most appropriate to use. If existence value is a major portion of the total value of the bighorn sheep herd, as hypothesized, the contingent valuation method (CVM) must be used.

The CVM is a survey method in which a hypothetical situation is presented to the consumer depicting an increase or decrease in the resource commodity of concern. For an increase in consumer welfare, respondents are asked how much they would be willing to pay to have the desired state, or willing to accept in compensation to forego the desired state. To estimate a decrease in consumer welfare, respondents are asked how much they would be willing to pay to avoid the undesired state, or how much they would accept in compensation to accept the undesired state. The CVM produces an appropriate estimate of (Hicksian) consumer surplus and is well grounded in economic theory as a valuation tool.

A number of issues must be addressed when using the CVM. These issues include the potential biases specific to the CVM, which are strategic bias, information bias, vehicle bias, and hypothetical bias. The existence of strategic bias, information bias, and vehicle bias have been tested for empirically and have been shown to be insignificant when care is taken in designing the survey instrument (Randall, Hoehn, and Brookshire 1983). Little is yet known empirically about hypothetical bias, therefore, it continues to be a major issue in the use of the CVM. Because the CVM is a survey method, other biases inherent to surveys must also be recognized. These biases and their implications are discussed below.

## Strategic Bias

The incentive respondents have to inflate or deflate their bid in order to affect policy decisions is one source of strategic bias. Bias from this source will cause a bimodal distribution of bids because respondents will either overstate or understate their bid depending on whether or not they favor the scenario. The existence of strategic bias from this source was empirically tested for by Schulze, d'Arge, and Brookshire (1981). They showed that, even when given incentives to bid strategically, respondents were generally honest. Other studies testing for strategic bias have obtained similar results and have concluded that most

subjects accurately report their personal valuations (Rowe and Chestnut 1982). This source of strategic bias can be minimized by stressing the hypothetical nature of the scenario or positing a less realistic or an unfamiliar scenario to the respondent. This solution, however, may present other problems which will be discussed below.

Another source of strategic bias, the free-rider problem, is the incentive respondents have to understate their bid in the belief that they, and others, will be asked to pay the amount they bid. Respondents who actually value the resource, have an incentive to understate their bid or bid zero in hopes that others will pay and they will benefit without having to pay. This phenomenon may also occur if respondents believe that others will free ride, and by contributing, they would be wasting their money by supporting a lost cause. The free-rider problem results in an underestimate of total value for that good (Just, Hueth, and Schmitz 1982).

The scenario presented to the respondent can be constructed to minimize free-riding. Cocheba and Langford (1981) informed the respondent that everyone would be required to pay, and if enough money could not be collected, donations would be returned. When estimating use value, the free-rider problem may be eliminated by stating an explicit exclusion mechanism in the contingent market. To estimate hunting values of bighorns and grizzly bear, Brookshire,

Eubanks and Randall (1983) informed respondents that only those who contributed to the fund to preserve these species, would be eligible for a hunting permit. This approach is not possible when estimating existence value, since existence value is a nonexcludable, public good. A general guideline for designing a scenario that minimizes free-riding is to present bids as payments that everyone will be required to pay, rather than as voluntary contributions (Rowe and Chestnut 1982).

Information Bias

Information bias may occur when the respondent is given too much information about the resource or a starting bid prior to an open-end bid question. In a study to estimate the value of bald eagles in Wisconsin, Boyle and Bishop (1985) used a closed-end, dichotomous choice question, followed by an open-end question. Respondents were asked, first, to accept or reject a randomly selected, fixed membership fee to a foundation to preserve bald eagles. Then the respondents were asked what maximum amount they would actually pay. An initial test for starting point bias indicated that eight out of 15 open-end bids were influenced by the fixed offers. A single, open-end willingness to pay question eliminates the possibility of a starting point bias.

Vehicle Bias

The method of payment, called the payment vehicle, may be yet another source of bias. Preestablished perceptions about a government agency such as the Fish and Wildlife Service, or an established environmental organization such as the Sierra Club, may arouse emotions, leading respondents to make responses that do not reflect their true value for the resource. A tax increase used as a payment vehicle may cause some respondents to reject the method. Vehicle bias can be avoided by specifying a neutral vehicle such as a "generic" trust fund (Rowe and Chestnut 1982; U.S. Water Resources Council 1979).

Hypothetical Bias

Careful wording of the CVM question can minimize strategic bias, information bias, and vehicle bias. Much less is known about the affects of hypothetical bias and how it might be controlled, making it a far more serious problem in using the CVM. Hypothetical bias implies that a hypothetical question will elicit a hypothetical response unrelated to what actual behavior might be. To avoid such bias, the scenario should be realistic and familiar to the respondent. In making the scenario realistic, however, care must be taken to avoid introducing incentives for strategic bidders. Past research suggests, however, that posing a realistic scenario will produce the most valid responses,

because subjects, even when given strong incentives to bid strategically, are generally honest (Schulze, d'Arge and Brookshire, 1981).

## Nonresponse Bias

Nonresponse bias is inherent to all mail surveys. When estimating the aggregate value of a resource to a population, how to handle the nonrespondents is an important, yet rarely mentioned issue (Edwards and Anderson 1986). Past studies have based their total value estimates on various assumptions regarding nonrespondents. If nonrespondents are assumed to be similar to respondents, they may be assigned the mean bid of respondents, or their bid may be estimated from an econometric model based on respondent characteristics. Sutherland and Walsh (1985), who obtained a 61 percent response rate to their survey, based their estimate of aggregate preservation value associated with protecting water quality on characteristics of respondents. Aggregate value estimates that are based soley on the characteristics of respondents tend to overestimate benefits to a degree proportional to the number of nonrespondents (Edwards and Anderson 1986).

Another approach for handling nonrespondents, which is not based on characteristics of respondents, is to assume they have no interest in the topic and, hence, no value for the resource. Based on this assumption, nonrespondents are

assigned a zero bid and, therefore, the population value is a minimum estimate of the value of the resource. A range for the aggregate value, in which the actual value is expected to fall, may be constructed by calculating a minimum and maximum estimate of value based on the above assumptions.

Specification of Property Rights

Another issue concerning the valuation of public goods using the CVM is the specification of property rights. Consider a proposal that will eliminate a wildlife resource, causing a decrease in consumer welfare. If individuals are asked how much they would be willing to accept in compensation to allow for the resource to be eliminated, the question implies that the consumer has property rights to the resource. If individuals are asked how much they would be willing to pay to save the wildlife resource from elimination, the question implies that the individual does not have property rights to the resource.

The way in which property rights are specified in the scenario will affect the amount of a respondent's bid. If income elasticity for the resource is positive, the willingness-to-accept compensation (WTA) measure will be greater than the willingness-to-pay (WTP) measure of consumer surplus (Brookshire, Randall and Stoll 1980). Although the consumer's income affects both WTA and WTP

measures, it has a greater effect on their WTP. This makes sense intuitively since consumers are faced with an explicit income constraint when asked how much they are willing-to-pay.

Empirical differences in willingness-to-pay and willingness-to-accept measures of welfare change have been mixed (Schulze, d'Arge and Brookshire 1981). Bishop and Heberlein (1980) set up a simulated market for goose hunting permits and compared those WTA measures to WTA and WTP equivalents from a hypothetical market (CVM). Because the simulated market results were based on real consumer transactions, they were considered to be the most valid. The hypothetical market WTA values were higher and the WTP values were lower than the simulated market results, both by a significant amount. The authors concluded that with hypothetical markets (CVM) neither the WTP or WTA approaches are without bias since WTA will tend to overestimate values, and WTP underestimate them (Bishop and Heberlein 1980). Differences in these measures may be partially explained by the income constraint present in WTP questions or the differences in implied property right structures (Schulze, d'Arge and Brookshire 1981).

Whether WTP or WTA is appropriate depends on the specific valuation problem. Brookshire, Randall and Stoll (1980) outline the theoretical basis for choosing WTP or WTA measures. They show that, for management alternatives that

propose a decrease in a wildlife resource, the theoretically correct estimate for benefit-cost analysis is produced by asking respondents their willingness to accept compensation. However, they go on to conclude that a WTP format produces a more effective and reliable measure than WTA, and thus, suggest that WTP be estimated. Studies have found that WTA scenarios, because of ethical principles and their unrealistic nature, have a higher rejection rate than WTP scenarios (Schulze, d'Arge and Brookshire 1981).

Validity

To conclude this discussion of CVM issues, a comment on contruct validity is appropriate. The construct of value is very complex. The CVM does not purport to measure the entire value construct, but only economic value, a small aspect of the value construct, which is the relevant concept for this study. In CVM research, economic value is empirically defined in dollars, specifically the amount an individual is willing to pay for a good, or willing to accept in compensation to go without the good.

Construct validity will further depend on the accuracy with which respondents choices on the questionnaire reflect their actual and expected behavior, a problem in all attitude research. Studies that have compared value estimates from the CVM with results of other nonmarket valuation techniques, indicate that the CVM is a valid

procedure for benefit estimation (Stoll 1983; Schulze, Brookshire et. al. 1983; U.S. Water Resources Council 1979). Knetsch and Davis (1966) have obtained similar results from the CVM and the travel cost method when estimating recreation benefits. The hedonic approach and CVM have also provided similar results (Brookshire, d'Arge, Schulze, and Thayer 1981). Keeping in mind the purpose of our estimate, and assuming respondents behave as they say they will, the CVM will provide an appropriate indicator of economic value useful to resource decision makers.

## Data Collection

### Sample

Data was collected using a mail survey of a sample of Tucson area households. The telephone directory was useful as the sample frame because it included the outlying areas of Vail, Catalina and Oracle Junction as well as the Tucson metropolitan area. These outlying areas were included because of their proximity to the Pusch Ridge area and Tucson. Households were selected using a random start and the appropriate sampling interval to obtain a sample of 1000 households (Dillman, 1978).

### Sampling Procedure

In October 1985 each household in the sample was mailed a questionnaire along with a business return envelope, and a letter of transmittal describing the study

and the need for cooperation. The letter requested that the head of the household respond to the items on the questionnaire and the directions for completion were explicitly stated on the questionnaire. The mailing time was set to include residents who spend summers away from Tucson and so responses would be returned before the holidays. A follow up "reminder / thank you" postcard and a second questionnaire were mailed one and three weeks after the initial mailing. A third mailing was not conducted due to cost constraints. This schedule was suggested by Dillman (1978) as part of the "Total Design Method" of conducting surveys.

Survey Instrument

CVM: Data for this study was collected from Parts II, III, and IV of a questionnaire that was mailed to each household in the sample (Appendix A). Three contingent valuation questions were presented to the respondent. Scenario 1 was used to elicit bids for the total value of the herd.

> Scenario 1:
>
> There is a herd of about 70 desert bighorn sheep living in the Pusch Ridge area of the Santa Catalina Mountains located nine miles north of Tucson. The next question presents an imaginary situation which asks for your best estimate of how you would respond.
>
> Suppose that the bighorns are threatened by human activity and development around Pusch Ridge. If

> something is not done, the bighorn sheep will not survive on Pusch Ridge and bighorn sheep will be eliminated from the Santa Catalina Mountains.
>
> Suppose that, in response to this problem, an independent, nonprofit foundation is set up to preserve the Pusch Ridge bighorns. The foundation will restore and maintain habitat for the bighorn sheep on Pusch Ridge and will be able to save this herd of bighorns from extinction.
>
> Imagine now that the foundation will be funded by selling annual supporting memberships. All members will be provided with information on the herd's status and information which would greatly increase the chances of seeing a bighorn in the area. Members who do not wish to view bighorns on Pusch Ridge, will have the satisfaction of knowing that they helped preserve the herd.

The purpose of the introduction was to identify the commodity for the respondent, taking care not to arouse emotions that might cause information bias. Included in the scenario are the following necessary components: a hypothetical situation that predicts a decrease in consumer welfare ("elimination of the bighorn sheep herd"), a proposed alternative that would, with certainty, avoid the situation that causes a decrease in consumer surplus, a neutral organization to act as a payment vehicle, and a statement on the benefits that contributers will receive. Because the location of Pusch Ridge as bighorn habitat is a unique aspect of the study, it was essential to include the PRWA as bighorn habitat in the scenario. The scenario states that the foundation will restore and maintain habitat as a means of preserving the herd. This will result in a

value estimate which includes the bighorn sheep and the Pusch Ridge area as bighorn sheep habitat.

Respondents were asked whether they would become a member of the foundation. Those who said "yes" were asked to report the maximum amount they would contribute annually to the foundation. Those who said "no" were questioned as to the reason for their response in order to distinguish true zero bidders from those who rejected the CVM.

Existence value was estimated from responses to Scenario 2, based on an approach by Boyle and Bishop (1985).

Scenario 2:

> Consider the hypothetical situation in question 1 again (Scenario 1). Continue to imagine that the foundation will be able to preserve the bighorns. This time, however, to eliminate disruptive activities that may cause stress to the sheep, the bighorns would not be available for public viewing.

Again respondents were asked how much they would be willing to pay annually to the foundation. This bid was intended to represent the respondent's existence value since all motivations for use, and the option to use the herd, were eliminated.

Recalling the conceptualization of wildlife values presented in the introduction (Figure 1), total value is the sum of use value and existence value (McConnell 1983). Because motives for use value are absent in Scenario 2, altruism must be the motivating source of the estimated value. Since interpersonal altruism is based on

contemporaries use of the herd, value from this source is eliminated from Scenario 2 as well. Therefore, Scenario 2 should have provided an estimate of existence value motivated by intrinsic altruism and intergenerational altruism.

A third scenario, which used a local tax as a payment vehicle, was presented to respondents. The purpose of this scenario was to identify free-riders and rejections to the payment vehicle in Scenario 1.

> Scenario 3:
>
> This time imagine that the only way to be sure the Pusch Ridge bighorns survive is to impose a local tax which everyone will have to pay. However, some of the taxpayers in Tucson do not feel that the bighorns are worth an additional tax.
>
> Under these conditions,do you think the bighorns should be preserved on Pusch Ridge?

Respondent Characteristics and Attitudes: Parts III and IV of the questionnaire were used to gather information about the respondents, including socioeconomic variables. Part III of the questionnnaire also included an attitudinal question (Question 4) which asked the respondents the extent to which they believe the managing agency should fund preservation of the herd. This item was included to provide an ordinal scale of value for comparison with the CVM response.

Question 5, also in part III of the questionnaire, was included to gather information on the motives underlying

| RESPONSE | VALUE | MOTIVE |
|---|---|---|
| So that I will have the option to see one in the future. | USE-OPTION | EGOCENTRISM |
| For hunting. | USE-CURRENT | |
| For scientific or educational purposes. | EXISTENCE | INTER-GENERATIONAL/ INTERPERSONAL ALTRUISM |
| For future generations, including my children and grandchildren. | EXISTENCE | INTER-GENERATIONAL ALTRUISM |
| For others who wish to see them. | EXISTENCE | INTERPERSONAL ALTRUISM |
| Because the bighorns have a right to live there. | EXISTENCE | INTRINSIC ALTRUISM |
| Because the bighorns are part of the ecosystem there. | EXISTENCE | |

* Motives pertaining to existence value were based on Randall and Stoll's (1983) conceptualization of intergenerational, interpersonal, and intrinsic altruisms.

Figure 2. Value and Motive* Concepts Represented by Responses to the Question: "What is the most important reason to <u>you</u> for preserving the bighorns on Pusch Ridge?"

respondents' value for the bighorns on Pusch Ridge. Figure 2 lists the value and motive concepts that were represented by each response category for question 5. Motives pertaining to existence value were based on Randall and Stoll's (1983) conceptualization of the intergenerational, interpersonal and intrinsic altruisms.

Below is a list of the variables used, and their empirical definitions.

| | |
|---|---|
| MEMBER | Whether or not the respondent would become a member of the foundation to preserve the herd; 1=Yes, 2=No. |
| NOTMEM | Reason for not becoming a member of the foundation to preserve the herd. |
| TOTALBID | Respondent's bid for use and existence of the herd estimated with Scenario 1. Positive, true zero, and uncertain bids are included. |
| EXBID | Respondent's bid for existence of the herd estimated with Scenario 2. Positive, true zero, and uncertain bids are included. |
| TAX | Whether or not the respondent favors a tax to preserve the herd; 1=Yes, 0=No. |
| VISIT | Whether or not the respondent has been to the Pusch Ridge Wilderness Area (PRWA); 1=Yes, 0=No. |
| SEESHEEP | Whether or not the respondent has seen bighorn sheep in the PRWA before; 1=Yes, 0=No. |
| HOPESEE | Whether or not the respondent as gone to the PRWA hoping to see sheep; 1=Yes, 0=No. |
| KNOWSHP | Whether or not the respondents knew of the bighorn sheep on Pusch Ridge prior to taking the survey; 1=Yes, 0=No. |

| | |
|---|---|
| OPTION | Whether or not the respondent hopes to see sheep on Pusch Ridge in the future; 1=Yes, 0=No. |
| MANAGE | Respondent's preferences for agency spending and management alternatives regarding preservation of the herd on Pusch Ridge. See questionnaire (Appendix A) for categories. |
| REASON | Respondent's most important reason for preserving the herd. |
| AGE | Age. |
| HSLDSIZE | Household size. |
| INCOME | Household income before taxes. |
| EDUC | Level of education. |
| CO | Number of conservation organizations the respondent belongs to. |
| PROXIM | Dummy variable to indicate proximity of respondent's home to Pusch Ridge. Two categories. |

## Methods of Analysis

### Respondent Characteristics

Frequency distributions, and mean or median values of respondent demographic variables are reported to describe the sociodemographic characteristics of the sample. To further describe the sample, information is reported on respondents' use and knowledge of the herd, use of PRWA, and preferences for agency spending and funding alternatives to preserve the herd.

In order to determine if the sample is representative of the population, sample frequencies were

compared to those reported in Tucson Trends (Valley National Bank and Tucson Newspapers Inc. 1986). Kolmogorov-Smirnov and chi-square tests were used to test for differences in the distributions of household income, education, age and zip code. Both surveys were conducted during the same year, but the sample frame for Pima County covered a larger area than did this survey. Adjustments were made for differences in geographical coverage by eliminating the zones (indicated by zip code) which were not surveyed in this study, from the Valley National Bank, Tucson Newspapers Inc. (1986) data. However, this adjustment was only possible for testing geographical similarities, based on zip code, between the two samples.

### Definition of Positive, Zero, Uncertain and Rejection Bids

For respondents who said they would support the foundation, their bid was recorded as the dollar amount they indicated that they would pay annually to the foundation. For respondents who said they would not support the foundation, their response to a following question, 1b, was used to interpret an acceptable, true zero bid or rejection bid. If they indicated that the herd was not worth anything to them, they could not afford membership to the foundation, or other causes take priority, they were assigned a bid of zero. All other responses to question 1b were considered as rejections to the CVM (Table 13, Appendix B). The mean bid

for respondents was estimated from all positive bids and true zero bids. Respondents who could not put a dollar value on the herd or volunteered rejection of the method, were assigned the mean bid for respondents on the basis that their rejection of the method was motivated by a positive value.

Those respondents who put a question mark for the amount they would pay annually to the foundation were considered uncertain bidders. Uncertain bidders who gave a reason for not becoming a member of the foundation, were assigned a true zero bid or rejection bid, depending on their response to question 1b, as explained above. Uncertain bidders who did not respond to question 1b, were assigned the mean bid for respondents.

Aggregate Value Estimates

Two estimates of total value and existence value were calculated, each under a different assumption regarding nonrespondents. The first estimate assumes that the bighorns have no value to nonrespondents and assigns them a zero bid. The second estimate assumes nonrespondents to be similar to respondents and assigns them the mean bid for respondents. Under each assumption, a per household bid was calculated. To calculate the aggregate value of the herd to Tucsonans, the low and high per household bids were

multiplied by an expansion factor of 235,200, representing the number of households in the population.

Validation of the CVM

A contingency test was conducted on responses to Scenario 1 and Scenario 3 to identify free-riders and rejections to the payment vehicles. Since both scenarios are indicators of whether the respondent values the herd, a chi-square test was useful for testing the internal validity among these two items on the questionnaire.

To validate Scenario 2 as a means of estimating existence value of the Pusch Ridge herd, recall from Figure 1 that,

TOTAL VALUE = USE VALUE + EXISTENCE VALUE.

Then,

USE VALUE = TOTAL VALUE - EXISTENCE VALUE.

If the measures of existence value (Scenario 2) and total value (Scenario 1) generated by this study are valid, their difference should approximate use value (including option value) (McConnell 1983).

We would expect that for those respondents who have seen or hope to see the Pusch Ridge bighorns or have visited the PRWA, the herd would have some use value. To test this hypothesis, a contingency test was conducted to determine whether users were more likely to have expressed a use value for the herd, than were nonusers, where use value was

defined as a positive difference between total value and existence value for each respondent.

A contingency test was conducted to determine whether respondents who indicated use value for the herd and those who did not, differed in their reasons for preserving the herd. It was expected that respondents who expressed use value for the herd would be more likely to choose use motives for preserving the herd more often than those who did not express use value.

## Bid Functions

In order to estimate the effects of socioeconomic variables on total value and existence value, bid functions were estimated for total value and existence value using multiple regression analysis. Dependent variables in the analyses were TOTALBID and EXBID. Independent variables in the regression were household income (INCOME), education (EDUC), age (AGE), the number of conservation organizations the respondent belongs to (CO), knowledge of the bighorn sheep on Pusch Ridge (KNOWSHP), desire to see sheep on Pusch Ridge in the future (OPTION), use of the Pusch Ridge Wilderness Area (VISIT), and proximity to Pusch Ridge (PROXIM).

## Motives for Value

To determine which motives underly the value of the herd to Tucsonans, we have assumed that the respondent's

most important reason for preserving the herd (REASON) is an indicator of his or her motives (Figure 2). To test the null hypothesis that, all motives for value are equally likely, a goodness-of-fit test between the sample frequency distribution on the variable REASON, and the uniform probability distribution was conducted. To test the hypothesis that intrinsic altruism is a major source of motivation for the herd's existence value, individual chi-square values were examined for those motives which represent intrinsic altruism. If intrinsic altruism is an important motive of value for the herd to Tucsonans, we would expect the observed frequency to exceed the expected by a significant amount.

The above analysis was used to test the hypothesis that, existence value is a major proportion of the total value for the herd. If existence value is a major proportion of the total value, we would expect the observed frequency to exceed the expected frequency for all altruistic motives by a significant amount.

# CHAPTER 3

# RESULTS AND DISCUSSION

This chapter begins with a summary of respondent characteristics. This is followed by results of the CVM, including bid functions and the motives underlying the value of the herd. Response to the survey is summarized in Table 1.

Table 1. Response to the Survey

| | |
|---|---|
| Original sample size | 1000 |
| Undeliverable | 64 |
| Adjusted sample size | 936 |
| Completed and returned questionnaires | 550 |
| Response Rate | 59% |

## Respondent Characteristics

### Socioeconomic Characteristics

Mean and medians of respondents' socioeconomic characteristics are shown in Table 2. Frequency distributions are presented in Appendix B.

Table 2. Mean and Median Respondent Socioeconomic Characteristics

| | |
|---|---|
| Median income class | $25,000 - 34,000 |
| Median education class | 3 years of college |
| Mean age | 47 years |
| Average no. of years in Tucson | 16 years |
| Mean household size | 2.6 persons |

To evaluate the representativeness of the sample, distributions of the respondents by zip code, household income, education and age were compared with secondary data on the population (Valley National Bank and Tucson Newspapers Inc. 1986). A chi-square test was conducted to test the hypothesis that there is no geographical difference, based on zip code, between the two samples. A chi-square of 36.15 with eight degrees of freedom was computed, indicating a significant difference at the 10 percent level (Table 14, Appendix B).

Distributions of the respondents by age, household income and education level were tested for goodness-of-fit with distributions of secondary data using the Kolmogrov-Smirnov test (Tables 15-17, Appendix B). For all three socioeconomic variables, the null hypotheses, that the samples did not differ on these aspects, had to be rejected at the .10 level of significance. A statistical test could not be applied to compare household size; however, the

household size of 2.6 for the sample seems quite close to the household size of 2.51 for the secondary data.

To determine whether respondents differed geographically from the sample, a chi-square test was conducted on the distribution of respondents zip codes and an expected distribution based on sample zip codes. The chi-square of 10.02 with 19 degrees of freedom showed that the observed frequency distribution of respondents by zip code is not significantly different than the sample at the .10 level of significance. This result suggests that self selection bias may not be present.

The above discussion indicates that the sample may be biased toward older, higher educated respondents, from larger, higher income households. It is possible that the sample frame did not adequately represent the population, causing bias in the sample. Another possible cause for the difference is that the sample population is different than the Pima County population, against which the sample population was tested. This explanation suggests an unbiased sample.

## Use and Knowledge of the Herd

Respondents were questioned on their use and knowledge of the herd and of the Pusch Ridge Wilderness Area (PRWA). Responses to these questions are summarized in Table 3.

Table 3. Respondents' Knowledge of the Pusch Ridge Herd and Use of the PRWA

| | |
|---|---|
| Knew of the bighorns on Pusch Ridge prior to the survey | 69% (367) |
| Hope to see bighorn sheep on Pusch Ridge in the future | 76% (392) |
| Have visited the PRWA before | 31% (168) |

The 168 respondents who had been to the PRWA before were asked if they had ever seen bighorn sheep there or if they had ever gone there hoping to see sheep. Results on these items are reported in Table 4, along with the results of a 1980 survey of visitors to the PRWA (Purdy 1980).

Table 4. Use of the Pusch Ridge Herd by Visitors of the PRWA

| | BUGARSKY 1985 STUDY | PURDY 1980 STUDY |
|---|---|---|
| Have seen bighorn sheep on Pusch Ridge. | 22% | 7% |
| Sample size | (168) | (800) |
| Went to Pusch Ridge hoping to see bighorn sheep. | 41% | 0 |
| Sample size | (168) | (84) |

The simplest explanation for the difference between the two studies is that increased public awareness of the Pusch Ridge bighorns has caused an increase in the use of the PRWA for the purpose of viewing bighorns. If a larger

percentage of the population in 1985 visits the PRWA with hopes of seeing bighorn sheep than did in 1980, it is likely that a larger percentage would actually see sheep, as these data support. Considering Tucson's population growth rate and the increasing interest in outdoor recreation, this is a plausible explanation.

## Attitudes on Preservation of the Herd

Respondents' preferences for agency spending to preserve the herd are reported in Table 18 (Appendix B). Responses to this question provide an alternative indicator of respondents' value for the herd. In aggregate, 73 percent of the respondents think the managing agency should go to at least "moderate expense" to preserve the herd, indicating that the herd has value to them.

In regards to funding the preservation of the herd, respondents were asked if they would favor a local tax. Consistent with the above result, 61 percent of the respondents said they would favor a local tax to preserve the Pusch Ridge herd. Thirty-nine percent said they would not. Because the respondent would be required to pay the tax, a positive response suggests that the herd is of value to the respondent.

A contingency test (Table 5) showed that a higher proportion of respondents who favored a tax also thought the managing agency should go to at least "moderate expense" to

Table 5. Cross Tabulation Between the Respondent's Preference for Management Spending to Preserve the Herd and Whether that Respondent Favors a Tax to Preserve the Herd.

| RESPONDENT'S PREFERENCE FOR MANAGEMENT SPENDING TO PRESERVE THE PUSCH RIDGE HERD | FAVORS A TAX | OPPOSES A TAX |
|---|---|---|
| THE MANAGING AGENCY... | | |
| should go to at least "moderate" expense to preserve the herd. | 94% | 49% |
| should be concerned, but go to no expense to preserve the herd. | 1 | 20 |
| should not be concerned about the herd. / No opinion | 5 | 31 |
| | 100% (290) | 100% (178) |

MISSING OBSERVATIONS (82)

RESULTS: chi-square=127.48, 2 degrees of freedom, Significance = 0.01

preserve the herd, than of those who did not favor a tax. A higher proportion of respondents who did not favor a tax thought the managing agency should "be concerned but not go to any expense," "not be concerned," or had no opinion regarding preservation of the herd. This result indicates internal consistency among these items in the survey instrument and lends support to the hypothesis that residents of Tucson value the herd.

## Valuation Results

Ninety-four percent of those responding to the questionnaire responded to the total value question and 92 percent to the existence value question. The distribution of positive bids, true zero bids, and rejection bids for total value and existence value, based on the criteria presented in the previous chapter, are shown in Table 6.

Table 6. Classification of CVM Bids

| | Total Value | Existence Value |
|---|---|---|
| Positive bids | 47% | 42% |
| True zero bids | 33 | 37 |
| Rejections to the CVM | 20 | 21 |
| | 100% (522) | 100% (502) |
| Overall Response Rate | 56% | 54% |
| Missing Observations | (28) | (48) |

The herd is of value to respondents. The mean bid for total value was $17.18, and $15.16 for existence value based on respondents who gave a positive dollar bid or were classified true zero bidders.

Evidence on use of the herd from an earlier study found that its use is minimal, and suggested that use value is a small proportion of the total value for the herd (Purdy and Shaw 1981). Recalling that total value is the sum of use value and existence value (McConnell 1983), then one would expect existence value to make up a major proportion of the total value for the herd. Results of this study lend support to the hypothesis that existence value is a major proportion of the total value for the herd. The mean existence value for respondents is 89 percent of their mean total value, and existence value and total value are highly correlated with a coefficient of determination of .96.

Two estimates were calculated for aggregate total and existence values, based on two assumptions regarding nonrespondents. One estimate assumed that the herd was of zero value to nonrespondents, and the other estimate assumed that the value of the herd to nonrespondents was equal to its mean value to respondents. For each assumption, a "per household" estimate was calculated (Table 7). The "per household" values were then expanded by the population size, 235,200 households, to estimate the aggregate values per year for the population.

Table 7. Per Household and Population* Values of the Pusch Ridge Bighorn Sheep Herd to Tucsonans Per Year under Two Assumptions Regarding Nonrespondents

| | NONRESPONDENTS | | | |
|---|---|---|---|---|
| | ASSIGNED ZERO BID | | ASSIGNED MEAN BID FOR RESPONDENTS | |
| | PER HOUSEHOLD | POPULATION | PER HOUSEHOLD | POPULATION |
| TOTAL VALUE | $9.55 | 2,248,220 | 17.14 | 4,031,328 |
| EXISTENCE VALUE | $8.12 | 1,910,246 | 15.14 | 3,560,928 |

* The expansion factor was 235,200, the number of households in the population.

The lower estimates are absolute minimums and are probably underestimates since it was assumed that the herd had no value whatsoever to all nonrespondents. On the other hand, the higher estimates may be overestimates because, generally, nonrespondents are not as interested in the survey topic as respondents and one would expect interest to be highly correlated with the value of the herd. The upper and lower estimates do, however, provide a range which probably includes the actual values.

Validation of the CVM

To detect free-riders and check for payment vehicle bias in Scenario 1, respondents were asked if they would favor a tax to preserve the herd (Scenario 3). Of those

respondents who said they would become a member of a foundation to preserve the bighorns, 79 percent also favored a tax for this purpose (Table 8). This group of respondents included those who revealed their value for the herd and any free-riders who understated their value for the herd. The 21 percent of the respondents who said they would become a member of the foundation, but did not favor a local tax, may have rejected a local tax as a payment vehicle.

Table 8. Cross Tabulation Between Respondents Who Favor a Local Tax to Preserve the Herd and Respondents Who Said They Would Become a Member of a Foundation to Preserve the Herd

| | MEMBER OF THE FOUNDATION | |
|---|---|---|
| | YES | NO |
| SUPPORT A LOCAL TAX | 79% | 42% |
| DO NOT SUPPORT A LOCAL TAX | 21% | 57% |
| | 100% (243) | 100% (229) |

MISSING OBSERVATIONS (77)

RESULTS: chi-square=63.75, 1 degree of freedom, Significance = 0.01

Of those who said they would not join the foundation, 43 percent favored a tax to preserve the herd. These respondents may have rejected the foundation as a payment vehicle. Because everyone who favored the tax would be required to pay the tax, this group would not include free-riders. Fifty-seven percent of those who said they would

not join the foundation to preserve the bighorns, did not favor a tax for this purpose. These respondents are either free-riders, do not value the herd, or have rejected both payment vehicles.

The difference between responses for Scenario 3 and Scenario 1 is significant at the .01 level, which indicates internal consistency between these items on the questionnaire. Although the various interpretations of this analysis are interesting, little is gained toward identifying free-riders for certain since the analysis is clouded with vehicle bias. Further research on this procedure, however, may contribute to our knowledge on appropriate payment vehicles and free-rider behavior.

To validate Scenario 2 as a means of estimating existence value of the Pusch Ridge herd, contingency tests were conducted on respondents' use of the herd and of the PRWA, against whether they had indicated use value for the herd. The presence of use value for this analysis was indicated by a positive difference between total value (TOTALBID) and existence value (EXBID) for the respondent.

We would expect respondents who had visited the PRWA (VISIT) to more likely have expressed use value for the herd than those who had not visited the PRWA. Of those respondents who had visited the PRWA, 81 percent indicated no use value (Table 9). Of those who had not visited PRWA, 89 percent indicated no use value. As expected, a larger

Table 9. Cross Tabulation Between Respondent's Use Value for the Herd and Whether the Respondent has Visited the PRWA

| | VISITED THE PRWA | |
|---|---|---|
| | YES | NO |
| USE VALUE > 0 | 18% | 11% |
| USE VALUE = 0 | 81% | 89% |
| | 100% (118) | 100% (245) |

MISSING OBSERVATION (186)

RESULTS: chi-square=3.80, 1 degree of freedom, Significance = 0.05

Table 10. Cross Tabulation Between Respondent's Use Value for the Herd and Whether the Respondent Hopes to See Sheep on Pusch Ridge in the Future

| | HOPE TO SEE SHEEP | |
|---|---|---|
| | YES | NO |
| USE VALUE > 0 | 16% | 3% |
| USE VALUE = 0 | 84% | 97% |
| | 100% (284) | 100% (67) |

MISSING OBSERVATIONS (198)

RESULTS: chi-square=6.93, 1 degree of freedom, Significance = 0.01

percentage of respondents who had visited the PRWA had use value for the herd. The difference, while small, is significant at the .05 level using a chi-square test.

We would also expect respondents who hope to see the sheep on Pusch Ridge in the future (Option) more likely to have option value, a component of use value, for them. Likewise, we would expect those who do not hope to see the sheep on Pusch Ridge not to have option value. Ninety-seven percent of those respondents who did not hope to see sheep in the future expressed no use value, which included option value, for the herd (Table 10). Eighty-four percent of those respondents who hoped to see sheep in the future expressed no use value for the herd. As expected, a larger percentage of respondents who hoped to see sheep in the future expressed use and option value for the herd, than of those who did not hope to see sheep. Using a chi-square test, the difference is significant at the .05 level.

It would be expected that for those respondents who have seen sheep in the PRWA (SEESHEEP), or have gone there hoping to see sheep (HOPESEE), the herd would have use value. Differences in use value for these variables could not be tested, however, because of an insufficient number of observations.

It would be expected that those respondents who expressed use value for the herd would be more likely to have egocentric motives for valuing the herd. The most

important reason given for preserving the herd was used as an indicator of motives (Figure 2). The chi-square showed no significant difference in motives, categorized as those underlying existence value or use value, between respondents who expressed use value for the herd and those who did not (Table 11). Keeping in mind that both users and nonusers of a resource may hold existence value for it, the result of the above analysis suggests that existence value is an important motive for both users and nonusers of the herd.

Table 11. Cross Tabulation Between the Motives Underlying the Respondent's Value for the Herd and the Respondent's Use Value for the Herd

| | USE VALUE | |
|---|---|---|
| | > 0 | = 0 |
| ALTRUISM | 87% | 92% |
| EGOCENTRISM | 13 | 8 |
| | 100% (45) | 100% (270) |

MISSING OBSERVATIONS (243)

RESULTS: chi-square=2.206, 1 degree of freedom, Not Significant

Bid Functions

Total and existence bid functions were estimated with Ordinary Least Squares to determine the influence of various respondent characteristics. Linear, semi-log and double-log functional forms were tested. The double log

form, shown below, achieved the best fit for the total bid function. T-values are reported in the parenthesis.

$$\ln \text{TOTALBID} = \underset{(-4.803)}{-0.50} + \underset{(6.249)}{0.55} \ln \text{INCOME} + \underset{(1.114)}{0.08} \text{EDUC}$$

$$+ \underset{(0.722)}{0.13} \text{KNOWSHP} - \underset{(-0.953)}{0.005} \text{AGE} + \underset{(0.220)}{0.04} \text{PROXIM}$$

$$+ \underset{(6.249)}{1.28} \text{OPTION} + \underset{(0.797)}{0.14} \text{VISIT} + \underset{(1.969)}{0.17} \text{CO} \qquad (1)$$

$R^2 = .28$
Adjusted $R^2 = .27$
$F = 15.959$ with 8 and 323 degrees of freedom
Significance = 0.0000

All variables in the regression equation, except age, have a positive influence on TOTALBID. It is consistent with consumer behavior theory that respondents' income, education and their membership with conservation organizations (since each organization has a membership fee), positively affect their value for the herd. We would also expect that the respondents' knowledge of the herd, their desire to see bighorns in the future, their tendency to visit the PRWA, and their proximity to the herd would positively influence the value they have for the herd. Age is the only variable that has a negative effect on a Tucsonan's value for the herd and is expected since elderly residents are less likely to visit the PRWA and less likely to see the herd there (or perceive that as an option) than younger residents of Tucson. Past studies suggest that

users of a resource hold a greater appreciation for it, and are expected to hold a greater value for it, than nonusers (Walsh, Loomis, and Gillman 1984).

Coefficients for ln INCOME, OPTION, and CO were significantly different from zero at the .01 level. The coefficient on ln INCOME (.56) represents the price flexibility of income for the good, which is preservation of the herd (Brookshire, Randall and Stoll 1980). Coefficients for EDUC, AGE, and CO represent the rate of change on bid for a unit change of the independent variable (e.g., a one-year increase in age results in a .5 percent decrease in TOTALBID).

The following bid function was estimated for existence value (EXBID), based on the same model as total value:

$$\begin{aligned} \ln EXBID = {} & -3.69 + 0.401 \ln INCOME + 0.157\ EDUC \\ & (-3.359) \quad (3.608) \qquad\qquad (2.114) \\ & + 0.324\ KNOWSHP - 0.009\ AGE + 0.041\ PROXIM \\ & (1.709) \qquad\quad (-1.827) \qquad (.210) \\ & + 1.014\ OPTION + 0.117\ VISIT + 0.19\ CO \\ & (4.756) \qquad\quad (0.651) \qquad\quad (2.038) \end{aligned} \tag{2}$$

$R^2 = .26$
Adjusted $R^2 = .24$
$F = 13.407$ with 8 and 305 degrees of freedom
Significance = 0.0000

As would be expected, the signs of the coefficients for existence value (equation 2) were the same as they were

for total value (equation 1), indicating that the independent variables affect total value and existence value in the same direction. According to existence value theory, use of, the option to use, and one's proximity to a resource are unrelated to existence value. However, these variables do increase one's appreciation for the resource, which does positively influence existence value (Walsh, Loomis, and Gillman 1984). This explains why VISIT, PROXIM, and OPTION have a positive influence on EXBID, and why AGE has a negative influence on EXBID.

The price flexibility of income on the existence of the herd was .41. All coefficients except those for VISIT and PROXIM were significantly different from zero at the .01 level. This is consistent with existence value theory, which states that existence value is not a function of an individual's use of the resource or proximity to it.

AGE, KNOWSHP, and EDUC, which were not significant in the total value function (equation 1), were significant in the existence value function (equation 2). To explain this, consider the following relationships. Age has a significant negative effect (at the .01 level) on education, and education has a significant positive effect on one's knowledge of the Pusch Ridge bighorns. One's knowledge of the bighorns causes a greater appreciation for them which increases that person's existence value for the herd.

There are more variables significantly affecting EXBID (equation 2) than there are affecting TOTALBID (equation 1). However, the overall effectiveness of the existence value model is less, as indicated by the coefficient of determination and the F statistic. A possible explanation for this could be that the model for existence value is not fully specified and there are other variables that influence it, but not total value.

## Motives for Valuation

Respondents were asked their three most important reasons for preserving the herd (Table 19, Appendix B). Responses to this item show that respondents believe that the herd should be preserved on Pusch Ridge because "it has a right to be there," and "it is part of the ecosystem there." Preservation of the herd for future generations received consistently high response as all three important reasons, implying that it is important as a primary and secondary motive.

The following results are based on the assumption that the most important reason given by respondents for preserving the herd was an indication of the motives underlying their value for the herd (Figure 2). The observed distribution of respondent motives for valuing the herd was tested for goodness-of-fit with an expected uniform distribution using a chi-square test (Table 12).

Table 12. Results of a Goodness-of-Fit Test of Respondents' Motives for Valuing the Herd with a Uniform Probability Distribution

| MOTIVE* | OBSERVED | EXPECTED | CHI SQUARE (%)** |
|---|---|---|---|
| EGOCENTRISM | 26 | 107.24 | 61.54 (16%) |
| INTERGENERATIONAL INTERPERSONAL ALTRUISM | 27 | 53.62 | 13.2 (3%) |
| INTERGENERATIONAL ALTRUISM | 87 | 53.62 | 20.81 (5%) |
| INTERPERSONAL ALTRUISM | 13 | 53.62 | 30.75 (8%) |
| INTRINSIC ALTRUISM | 263 | 107.24 | 226.23 (60%) |
| OTHER | 13 | 53.62 | 30.75 (8%) |
| TOTAL | 429 | 429 | 386.25 (100) |

MISSING OBSERVATIONS (120)
RESULTS: chi-square = 383.28, 5 degrees of freedom, Significance = 0.01

* Motives are listed in Figure 2.

** Percent represents the amount the individual chi-square contributes to the total chi-square.

The distributions were significantly different at the .01 level, which lead us to reject the null hypothesis that the motives for valuing the herd are of equal importance.

Results of this analysis provide insight as to which motives underlying the respondents' value for the herd are most important. The largest discrepancy between observed and expected frequencies, accounting for 60 percent of the final chi-square, is associated with motives representing intrinsic altruism. Observed responses exceed the expected for these motives, indicating that intrinsic altruism is a major source of motivation for the herd's value, as hypothesized. Egocentrism accounted for 16 percent of the final chi-square, and the observed frequency is well below the expected. This indicates that egocentrism is not an important source of motivation for the herd's value.

From this analysis, it is apparent that, in aggregate, all types of altruism occur more than expected. Because existence value is motivated by altruism, this result supports the hypothesis that existence value is a major proportion of the total value for the herd. Because egocentrism occurs less than expected, use value appears to contribute little to the total value of the herd.

# CHAPTER 4

# SUMMARY AND POLICY IMPLICATIONS

This chapter will summarize the major results of the study and discuss their general implications for policy.

## Summary

The results show that residents of the Tucson urban area are aware of the bighorns on Pusch Ridge. Even though few residents visit the Pusch Ridge area and even fewer actually see bighorns there, a very large proportion (76%) express an interest in seeing bighorns in the PRWA in the future.

Responses to the attitude and the CVM questions indicate that residents of Tucson value the Pusch Ridge herd. The mean total value of the herd to respondents was $17.14 per year, and the mean existence value was $15.16 per year. These estimates were generalized to the Tucson population based on two assumptions regarding nonrespondents, resulting in a value range for total value and existence value. We would expect the total value of the herd to the population to fall between $2,248,220. and $4,031,328. per year. Existence value for the herd is estimated to fall between $1,910,244. and $3,560,928. per

year. Considering these are annual values, they are quite substantial.

Responses to attitude questions on preservation of the herd support the conclusion that the herd is of important value to residents of Tucson. Sixty percent of the respondents answered favorably when asked their preferences for management spending to preserve the herd, and whether they favor a tax to preserve the herd (Scenario 3). These indicators of value support the above conclusions based on the CVM.

Results of the CVM and analysis of respondents' motives indicate that existence value is a major portion of the total value of the herd. Specifically, intrinsic altruism appears to be a very important motive underlying the existence value of the herd. Egocentrism, the motive for use and option value, is of little importance as a value motivation.

## Policy Implications

The herd's existence and its habitat contribute to the social well-being of Tucson residents, and actions which affect the herd or its habitat will affect the social welfare of Tucsonans. Since bighorn habitat is a beneficial use of the PRWA, decision makers should consider preservation of Pusch Ridge for bighorn habitat as a viable land use alternative. Further, they should consider the

economic impacts of their decisions which affect the herd or the Pusch Ridge habitat.

The CVM results indicate substantial values for the herd per year. The present value of the herd, the appropriate estimate for benefit-cost analysis, is, of course, even greater, indicating that the benefits of preserving Pusch Ridge as bighorn habitat may be comparable with the benefits provided by urban development on Pusch Ridge.

The net benefit of preserving the herd (the benefits less the costs of preservation) is one criterion by which decision makers may use this information to evaluate management alternatives for the Pusch Ridge area. The costs of preservation include direct costs, such as those related to research and habitat maintenance, as well as indirect costs or opportunity costs of preserving Pusch Ridge as bighorn habitat. If net benefits are greater than zero, it is economically efficient to preserve the herd. Economic efficiency, however, is not the only criterion for evaluating alternatives. Decision makers must also keep in mind the equity of alternatives and the value over time of preserving the herd.

Studies have suggested that recreational use of the PRWA and the herd may be contributing to the decline in sheep numbers (Anon. 1985; Purdy and Shaw 1981), thus, indicating that recreational use of the PRWA and

preservation of Pusch Ridge for bighorn habitat may be conflicting uses of the Pusch Ridge area. This further implies a trade-off between use value and existence value of the Pusch Ridge herd. Purdy and Shaw's (1981) survey of visitors to the PRWA revealed that the majority of the visitors favored use restrictions as action to preserve the herd. If use of the PRWA indeed has a detrimental affect on the Pusch Ridge herd, a decrease in use of the PRWA may be a plausible management alternative for their preservation.

The CVM results from this study suggest some possible economic impacts of implementing this alternative to preserve the herd. Recall that existence value is a large proportion, and use value is a small proportion, of the total value of the herd. This suggests that a decrease in use of the herd may not substantially decrease its total value to residents of Tucson. However, this study did not estimate the value of the PRWA except with relation to use of the Pusch Ridge herd. It is highly likely that the PRWA has use value for activities other than seeing bighorn sheep, such as birdwatching or hiking. Therefore, further research on the value of the PRWA is necessary to develop firmer policy recommendations on its use.

The land allocation decisions involving the Pusch Ridge bighorn sheep herd are different than many wildlife management decisions in the past because the alternative uses of the Pusch Ridge area include intense recreational

use and urban development. Also complicating the Pusch Ridge problem is the involvement of multiple agencies whose decisions may affect the herd. For example, Pima County planning and zoning regulations may have an affect on the herd. Although the Arizona Department of Game and Fish has jurisdiction over the herd, the Coronado National Forest manages its habitat.

Management problems similar to the situation on Pusch Ridge will become more common as urban development continues to interface with rural land. In order for decision makers to make informed policy and management decisions that maximize the benfits to society, they need information on the values of wildlife resources. This study was a successful attempt to generate such information on the value of an urban wildlife resource.

# APPENDIX A

## THE QUESTIONNAIRE

The following pages contain Parts II, III, and IV of a questionnaire on wildlife values, which was used to collect the data for this study.

PART II: VALUING BIGHORN SHEEP

Resource managers are interested in the amount of future interest which people will have in wildlife. There is a herd of about 70 desert bighorn sheep living in the Pusch Ridge area of the Santa Catalina Mountains north of Tucson. The next question presents an imaginary situation which asks for your best estimate of how you would react.

Suppose that the bighorns are threatened by human activity and development around Pusch Ridge. If something is not done, the bighorn sheep will not survive on Pusch Ridge and the last bighorn sheep will be eliminated from the Santa Catalina Mountains.

Suppose that, in response to this problem, an independent, nonprofit foundation is set up to preserve the Pusch Ridge bighorns. The foundation will restore and maintain habitat for the bighorn sheep on Pusch Ridge and will be able to save this herd of bighorns from extinction.

Imagine now that the foundation will be funded by selling supporting memberships. All members will be provided with information on the herd's status and information which would greatly increase the chances of seeing a bighorn in the area. Members who do not wish to view bighorns on Pusch Ridge, will have the satisfaction of knowing that they helped preserve the herd.

1. WOULD YOU CONTRIBUTE TO THE FOUNDATION TO PRESERVE THE PUSCH RIDGE BIGHORNS?

_____YES

_____NO

a. IF YES, WHAT IS THE HIGHEST AMOUNT THAT YOU WOULD PAY IN 1986 FOR A YEARLY SUPPORTING MEMBERSHIP TO HELP PRESERVE THE BIGHORNS ON PUSCH RIDGE?

$_____

(GO TO QUESTION 2)

b. IF NO, YOU WOULD NOT BECOME A MEMBER AT ANY PRICE, WHY NOT?

_____THE HERD OF BIGHORNS IS NOT WORTH ANYTHING TO ME.

_____I CANNOT AFFORD TO BECOME A MEMBER AT THIS TIME.

_____I CANNOT PLACE A DOLLAR VALUE ON BIGHORN SHEEP.

_____I DON'T HAVE ENOUGH INFORMATION TO ANSWER.

_____OTHER, PLEASE EXPLAIN _____

_____

(GO TO QUESTION 3)

2. Consider the hypothetical situation in question 1 again. Continue to imagine that the foundation will be able to preserve the bighorns. This time however, to eliminate disruptive activities which may cause stress to the sheep, the bighorns would not be available for public viewing.

IN THIS SITUATION, HOW MUCH WOULD YOU BE WILLING TO PAY FOR A YEARLY SUPPORTING MEMBERSHIP TO THE FOUNDATION IN 1986?

$_____

3. This time imagine that the only way to be sure the Pusch Ridge bighorns survive is to impose a local tax which everyone will have to pay. However, some of the taxpayers in Tucson do not feel that the bighorns are worth an additional tax.

UNDER THESE CIRCUMSTANCES, DO YOU THINK THE BIGHORNS SHOULD BE PRESERVED ON PUSCH RIDGE?

_____YES _____NO

PART III: BIGHORN SHEEP

In the following questions we are interested in your knowledge and opinion about the Pusch Ridge bighorns.

1.a. Have you ever visited any of the following areas in the Pusch Ridge area?

(CHECK ALL AREAS YOU HAVE VISITED)

_____PIMA CANYON

_____ROMERO CANYON

_____FINGER ROCK CANYON

_____OTHER AREAS IN PUSCH RIDGE WILDERNESS. EXPLAIN _____

_____

_____NO, HAVEN'T BEEN TO PUSCH RIDGE.

(SKIP TO QUESTION 2)

b. Have you ever seen bighorn sheep in the Pusch Ridge Area?

_____YES _____NO

c. Have you ever visited the Pusch Ridge area with direct hopes of seeing bighorn sheep?

_____YES _____NO

2. Is this questionnaire the first time you have heard about or learned that there are bighorn sheep in the Santa Catalina Mountains?

_____YES _____NO

3. Do you hope to see desert bighorn sheep in the Pusch Ridge area in your lifetime?

_____YES _____NO

4.a. Which of the following statements best describes your feelings about the management of the bighorns on Pusch Ridge?

_____a. THE MANAGING AGENCY SHOULD GO TO WHATEVER EXPENSE IT TAKES TO PRESERVE THE BIGHORNS ON PUSCH RIDGE.

_____b. THE MANAGING AGENCY SHOULD GO TO CONSIDERABLE EXPENSE TO PRESERVE THE BIGHORNS ON PUSCH RIDGE.

_____c. THE MANAGING AGENCY SHOULD BE CONCERNED, BUT ONLY GO TO MODERATE EXPENSE TO PRESERVE THE BIGHORNS ON PUSCH RIDGE.

_____d. THE MANAGING AGENCY SHOULD PRESERVE THE BIGHORNS ON PUSCH RIDGE AS LONG AS IT DOES NOT COST ANYTHING TO DO SO.

_____e. THE MANAGING AGENCY SHOULD NOT BE CONCERNED ABOUT THE BIGHORNS ON PUSCH RIDGE.

_____f. NO OPINION

(GO TO PART IV)

b. Of the following list, rank the three most important reasons to you for preserving the bighorns on Pusch Ridge.

1 = MOST IMPORTANT
2 = SECOND MOST IMPORTANT
3 = THIRD MOST IMPORTANT

"I'D LIKE THE PUSCH RIDGE BIGHORNS PRESERVED..."

_____a. SO THAT I WILL HAVE THE OPTION TO SEE ONE IN THE FUTURE.

_____b. FOR SCIENTIFIC OR EDUCATIONAL PURPOSES.

_____c. FOR FUTURE GENERATIONS, INCLUDING MY CHILDREN AND GRANDCHILDREN.

_____d. FOR HUNTING.

_____e. BECAUSE THE BIGHORNS HAVE A RIGHT TO LIVE THERE.

_____f. BECAUSE THE BIGHORNS ARE PART OF THE ECOSYSTEM THERE.

_____g. FOR OTHERS WHO WISH TO SEE THEM.

_____h. OTHER, PLEASE EXPLAIN _____

_____

PART IV: HOUSEHOLD INFORMATION

Finally, in order to make any meaningful conclusions from this survey we need to know a few things about you and your household. Please remember that your name will NEVER be associated with these answers.

1. Your age? _____

2. Number of people in your household? _____

3. How many years have you lived in the Tucson area? _____YEARS

4. How long do you plan to live here? _____YEARS

5. Which category best expresses your total annual household income, before taxes?

_____UNDER 5 ,000
_____5,000 - 9,999
_____10,000 - 14,999
_____15,000 - 19,999
_____20,000 - 24,999
_____25,000 - 34,999
_____35,000 - 49,999
_____50,000 - 74,000
_____74,000 OR MORE

6. What is your highest level of education?

_____ 3 YEARS OF HIGH SCHOOL OR LESS
_____ HIGH SCHOOL GRADUATE
_____ 1 - 3 YEARS COLLEGE OR TECHNICAL SCHOOL
_____ COLLEGE GRADUATE
_____ GRADUATE STUDIES

7. Please indicate the category which best describes your home.

_____ APARTMENT
_____ TOWNHOUSE / CONDOMINIUM
_____ MOBILE HOME / TRAILER
_____ SINGLE FAMILY HOME ON LESS THAN 1/4 ACRE
_____ SINGLE FAMILY HOME ON 1/4 ACRE TO 1 ACRE
_____ SINGLE FAMILY HOME ON MORE THAN 1 ACRE
_____ OTHER, EXPLAIN:_____

8. How is your yard landscaped? (For example 1/2 burmuda grass, 1/2 native desert vegetation.)

_____

_____

_____

9. Please list any conservation organizations which you are a member of and how much you contribute to each per year. (FOR EXAMPLE: ARIZONA SONORA DESERT MUSEUM, SIERRA CLUB)

_____

_____

_____

10. If you have any additional comments, please write them in the space below.

* THANK YOU VERY MUCH FOR YOUR TIME AND ATTENTION*

# APPENDIX B

## SUPPLEMENTARY TABLES

Table 13. Frequency Distribution of Respondents' Reasons for Not Becoming a Member of the Foundation to Preserve the Bighorns on Pusch Ridge

| "WHAT REASON BEST DESCRIBES WHY YOU WOULD NOT BECOME A MEMBER AT ANY PRICE?" | PERCENT |
|---|---|
| Bighorns not worth anything to me* | 14 |
| I cannot afford to become a member* | 44 |
| I cannot place a value on the bighorns | 8 |
| Not enough information to answer | 17 |
| Other causes take priority* | 4 |
| The situation is not realistic | 1 |
| Other / multiple responses | 12 |
| TOTAL | 100% (276) |

RESPONDENTS WHO SUPPORT THE FOUNDATION (246)
MISSING OBSERVATIONS (28)

* Indicate a true zero bid. All other responses indicate rejections to the CVM.

Table 14. Results of a Chi-Square Goodness of Fit Test on the Geographical Distribution of Respondents with Secondary Data* on the Population

| ZONE (based on zip code) | OBSERVED | EXPECTED | CHI-SQUARE |
|---|---|---|---|
| 1 | 74 | 48.6 | 13.27 |
| 2 | 14 | 21.6 | 2.67 |
| 3 | 49 | 64.8 | 3.85 |
| 4 | 89 | 81.0 | 0.79 |
| 5 | 93 | 81.0 | 1.77 |
| 6 | 47 | 43.2 | 0.33 |
| 7 | 65 | 54.0 | 2.24 |
| 8 | 40 | 43.2 | 0.24 |
| 9 | 69 | 102.6 | 11.00 |
| TOTAL | 540 | 540.0 | 36.15 |

MISSING OBSERVATIONS (9)
RESULTS: chi-square = 36.15, 8 degrees of freedom,
Significant at .10, Reject the Null Hypothesis

* Valley National Bank and Tucson Newspapers Inc. (1986)

Table 15. Results of a Kolmogrov-Smirnov Goodness of Fit Test on Respondents' Age with Secondary Data* on the Population

| AGE | OBSERVED CUM. FREQ. S(X) | EXPECTED CUM. FREQ. F(X) | \|F(X)-S(X)\| |
|---|---|---|---|
| Under 25 | .070 | .10 | .030 |
| 25 - 34 | .303 | .38 | .070 |
| 35 - 44 | .533 | .57 | .037 |
| 45 - 54 | .664 | .71 | .046 |
| 55 - 64 | .785 | .84 | .055 |
| 65 and over | 1.00 | 1.00 | 0.000 |

RESULTS: N=544, D = MAX|F(X)-S(X)|=.07 > .052, Reject the Null Hypothesis

* Valley National Bank and Tucson Newspapers Inc. (1986)

Table 16. Results of a Kolmogrov-Smirnov Goodness of Fit Test on Respondents' Education with Secondary Data* on the Population

| EDUCATION | OBSERVED CUM. FREQ. S(X) | EXPECTED CUM. FREQ. F(X) | \|F(X)-S(X)\| |
|---|---|---|---|
| 3 Years of College or less | .059 | .10 | .041 |
| High School Grad. | .228 | .46 | .232 |
| 1-3 Years College | .520 | .72 | .200 |
| College Graduate | .736 | .86 | .124 |
| Graduate Studies | 1.00 | 1.00 | 0.000 |

RESULTS: N=538, D = MAX|F(X)-S(X)|=.232 > .052, Reject the Null Hypothesis

* Valley National Bank and Tucson Newspapers Inc. (1986)

Table 17. Results of a Kolmogrov-Smirnov Goodness of Fit Test on Respondents' Income with Secondary Data* on the Population

| INCOME | OBSERVED CUM. FREQ. S(X) | EXPECTED CUM. FREQ. F(X) | \|F(X)-S(X)\| |
|---|---|---|---|
| Under 10,000 | .128 | .13 | .002 |
| 10,000 - 14,999 | .237 | .27 | .033 |
| 15,000 - 19,999 | .326 | .41 | .084 |
| 20,000 - 24,999 | .437 | .56 | .087 |
| 25,000 - 49,999 | .816 | .91 | .094 |
| 50,000 and over | .999 | 1.00 | .001 |

RESULTS: N=495, D = MAX|F(X)-S(X)|=.094 > .054, Reject the Null Hypothesis

* Valley National Bank and Tucson Newspapers Inc. (1986)

Table 18. Frequency Distribution to Responses to the Question: "Which of the following statements best describes your feelings about the management of the bighorns on Pusch Ridge?"

| THE MANAGING AGENCY SHOULD... | PERCENT |
|---|---|
| a. go to whatever expense to preserve the bighorns on Pusch Ridge. | 18 |
| b. go to considerable expense to preserve the bighorns on Pusch Ridge. | 26 |
| c. be concerned, but only go to moderate expense to preserve the bighorns. | 29 |
| d. preserve the bighorns on Pusch Ridge as long as it does not cost anything to do so. | 8 |
| e. not be concerned about the bighorns on Pusch Ridge. | 1 |
| f. No opinion / multiple response | 18 |
| TOTAL | 100% (521) |
| MISSING OBSERVATIONS (28) | |

Table 19. Frequency Distribution of Respondents' Three Most Important Reasons to Preserve the Bighorn Sheep on Pusch Ridge

| REASON TO PRESERVE THE BIGHORN SHEEP ON PUSCH RIDGE | MOST IMPORTANT | SECOND MOST IMPORTANT | THIRD MOST IMPORTANT |
|---|---|---|---|
| a. Option to see one | 5% | 9% | 22% |
| b. Scientific / Educational Purpose | 6 | 10 | 14 |
| c. Future generations Bequest Value | 20 | 27 | 28 |
| d. Hunting | 1 | 1 | 5 |
| e. Bighorns have rights to be there | 30 | 18 | 7 |
| f. Bighorns are part of the ecosystem | 32 | 28 | 8 |
| g. For others to see | 3 | 6 | 16 |
| h. other reasons | 3 | 1 | -- |
| TOTAL | 100% (430) | 100% (412) | 100% (405) |
| MISSING OBSERVATIONS | (120) | (138) | (145) |

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