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DISSERTATION

TESTING FOR ROBUSTNESS OF DICHOTOMOUS CHOICE CONTINGENT
VALUATION WILLINGNESS TO PAY ESTIMATES FOR THREATENED AND
ENDANGERED WILDLIFE SPECIES

Submitted by

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In partial fulfillment of the requirements

for the Degree of Doctor of Philosophy

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Summer 1999

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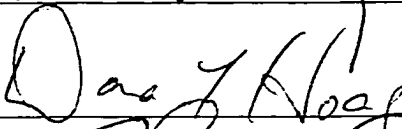
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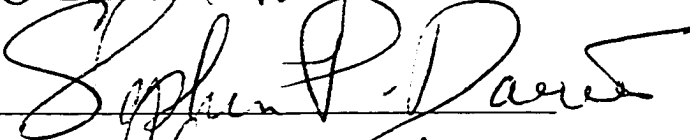
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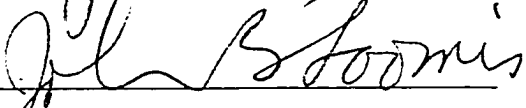
WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY KELLY L. GIRAUD ENTITLED TESTING FOR ROBUSTNESS OF DICHOTOMOUS CHOICE CONTINGENT VALUATION WILLINGNESS TO PAY ESTIMATES FOR THREATENED AND ENDANGERED WILDLIFE SPECIES BE ACCEPTED AS FULFILLING IN PART REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY.


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ABSTRACT OF DISSERTATION

TESTING FOR ROBUSTNESS OF DICHOTOMOUS CHOICE CONTINGENT
VALUATION WILLINGNESS TO PAY ESTIMATES FOR THREATENED AND
ENDANGERED WILDLIFE SPECIES

Economic theory suggests willingness to pay (WTP) should be significantly higher for a comprehensive good than for a subset of that good. This was tested for by using both a split sample design and paired responses for WTP for several endangered fish and wildlife species in the U.S. In the paired response case correlation between the error terms of willingness to pay response models were corrected for by using a bivariate probit model. Surprisingly, the independent split samples passed the scope test but the paired samples did not. Because the results contradict each other, questions of validity for policy implications are raised. However, using either approach, the benefits of maintaining critical habitat for these species exceeds the costs.

Economic theory also suggests that willingness to pay for two goods independently offered should remain unchanged when the survey instrument changes slightly. Four survey treatments consisting of a comprehensive good and a subset of that good were used. The surveys alternated in the question ordering and in the embedded good which accompanied the comprehensive good. Sequencing and instrument context

effects were tested for by using both a combined and split sample designs. In the combined sample case we found some evidence of sequencing effects in the data containing the first subset good. Likelihood ratio tests indicated that sequencing did not effect scale or location of parameters. In the test for instrument context effects, evidence was found indicating context does effect willingness to pay estimates.

The contingent valuation method is the only available method to estimate passive use values. This method is controversial for many reasons, including the techniques used to estimate willingness to pay. This paper demonstrates that while the confidence intervals do not indicate significant differences between various modeling techniques, the mean and median WTP estimates vary relative to each other. This can lead to conflicting interpretations of what the data show. Resource managers need to use caution when interpreting results until an industry standard can be developed for WTP estimates.

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DEDICATION

This dissertation is dedicated to the two people who made this project and degree possible: Ms. Susanne Giraud and Dr. John Loomis.

Susanne Giraud has shown through example that the most difficult of obstacles can be overcome through hard work and determination. She is not only my mother, but my inspiration and role model. John Loomis has given me seemingly endless encouragement, guidance and patience. I could not have asked for a better advisor or mentor.

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Chapter 1 BACKGROUND

1.1 THREATENED AND ENDANGERED SPECIES IN THE FOUR CORNERS REGION

The “Four-Corners” region of the United States (Southern Utah, Southeastern Colorado, Western New Mexico, and Arizona) boasts wide variety of diverse ecosystems. Unfortunately, because of resource extraction and the introduction of non-native species, a total of 110 plant and animal species are listed as threatened or endangered (T&E) in this area. Of the 110 T&E species, 62 species live exclusively in this region and no where else on earth (U.S. DOI, 1994).

1.1.1 The Mexican Spotted Owl

The Mexican spotted owl (*Strix Occidentalis Lucida*) stands about 16 to 19 inches tall, has brown eyes and white spots on brown and black feathers. The owl lives in old or virgin forests in the Southwestern part of the United States. Mexican spotted owls (MSOs) primarily live in multistoried, closed canopy, virgin mixed conifer tree stands. These stands usually contain trees such as Ponderosa pine, Gamble oak, Douglas fir, and Hemlock-Sitka spruce with a high density of trees, many snags, and an abundance of big logs (USDA, 1991).

Ganey and Russell (1994) found that the owls consistently avoid managed forests altogether, even those with uneven-aged selective-cut management practices. Favored areas are deep fractured rock canyons, areas with steep slopes, and deciduous riparian woodlands in mid to high elevations (4,000 - 10,000 feet above sea level). The owls forage at night, generally in more than one location. Their diet consists of mammals, birds, reptiles and insects, with woodrats (*Cricetidae Neotoma*) being the meal of choice, and the “perch and dive” strategy being employed most (Ganey, 1992).

Nesting habitat is most often in coniferous trees or rock hollows. Spotted owls lay eggs once a year, ordinarily in late April. Depending on the food supply, 2 eggs a year is most common, but MSOs have been known to lay up to 4 at one time. Incubation takes about 21 to 28 days, and both male and female MSOs take part in raising their young (Zarn, 1974). Even though MSOs are able to reproduce for the majority of their 30 year life span, recent studies estimate the population has dropped dramatically to about 806 pairs and 548 singles 2160 owls in total (U.S. DOI, 1993).

Because of the declining population trends, in April of 1993 the Mexican spotted owl was listed by the U.S. Fish and Wildlife Service as a threatened species. In 1995, 4.6 million acres of critical habitat units (CHUs) were designated in the Four-Corners region of the United States. Of the CHUs, 3.6 million acres are National Forest, and 871,000 acres are Native American lands. The CHUs were designated because some biologists believe that the Mexican spotted owl (MSO) would likely become extinct within fifteen years without protection. Much like the Northern spotted owl (*Strix Occidentalis Caurina*), listing and protection strategies for the MSO are surrounded by controversy.

Because the owl primarily resides in multi-storied, closed canopy, mature mixed conifer and Ponderosa pine/Gamble oak in montane forests, the main threats to its existence are even aged timber harvesting, short rotations, and forest fires. In 1993, the listing of the MSO severely restricted logging of old growth forests in the four corners region, but unlike the Northern Spotted owl, the net benefits of foregone timber harvesting are relatively minimal because of the below-cost timber sales common in the region. The major costs associated with the protection policy are the recovery efforts. The U.S. Fish and Wildlife Service estimates the recovery costs over the next ten years will include \$260,000 to amend federal resource management plans, \$19.8 million for monitoring, \$8.3 million for related research, and \$10.1 million for other features of the recovery plan. This leads to an average of \$4 million a year for the next ten years, and if successful, will result in the delisting of the species in 15 years (U.S. DOI, 1995).

1.1.2. Nine Threatened and Endangered Fish Species

Native fish species are also in danger due to manipulation of their habitat. In Arizona, 80% of the rivers have been altered by man, either physically or chemically. Today, 60% of the native fish species in the Southwest are considered endangered, threatened, or of special concern by state and federal agencies (Rinne and Fletcher, 1994). Nine species are highlighted in this study because of their protection by the U.S. Fish and Wildlife Service in CHUs. These species are listed as endangered by their respective state Fish and Game agencies and either threatened or endangered by the U.S. Fish and Wildlife Service.

The species are: the Bonytail Chub (*Gila Elangans*), Colorado Squawfish (*Ptychocheilus Lucius*), Humpback Chub (*Gila Cypha*), Loach Minnow (*Rhinichthys Cobitis*), Razorback Sucker (*Xyrauchen Texanus*), Rio Grande Silvery Minnow (*Hybognathus Amarus*), Spikedace (*Meda Fulgida*), Virgin River Chub (*Gila Robusta Semidnuda*), and the Woundfin (*Plagopterus Argentissimus*). Currently, 2,456 miles of river in the Colorado, San Juan, Virgin, Gila, and Rio Grande Rivers are designated as critical to the survival to these species. Of the above species, the Bonytail Chub, Colorado Squawfish, Humpback Chub, Razorback Sucker, Rio Grande Silvery Minnow, Virgin River Chub, and the Woundfin are all listed as endangered species. The Loach Minnow and the Spikedace are listed as threatened species. Although the U.S. Fish and Wildlife Service has determined that a listing of endangered is warranted for the Loach Minnow and the Spikedace, they do not have the resources to perform the work necessary for uplisting (VPI h, 1996, and VPI j, 1996).

Smith, Miller and Sable (1978) found that different species within the *Gila* genus (the “Chubs”) could in fact interbreed and produce fertile offspring. This suggests that the three Chub species are perhaps subspecies of the *Gila Robusta* group. Regardless of their species or subspecies status, the Humpback Chub is considered the closest to extinction out of all of the native Colorado River fishes (VPI, 1996b). Evidence of this species has been found in ancient Aztec Ruins in New Mexico (VPI, 1996b). All of the Chubs are endangered due to alteration of waterways, parasites, and predation by non-native species.

1.2 HISTORY OF THE CONTINGENT VALUATION METHOD

Nonmarket Valuation techniques generally fall into two categories, 1) revealed preferences and 2) stated preferences. Among the more common techniques are the Travel Cost Method, the Hedonic Pricing Technique, Household Production Functions, Conjoint Analysis, and Contingent Valuation Method. Travel Cost, Hedonic Pricing and Household Production use revealed preferences through observable behavior in order to estimate values for nonmarket goods. Conjoint Analysis and Contingent Valuation use stated preferences resulting from hypothetical markets in order to estimate values for nonmarket goods.

The origin of the Contingent Valuation Method (CVM) dates back to 1947 in an article that looked at soil conservation and capital returns. Ciriacy-Wantrup suggested using the direct interview method to elicit values for environmental goods. It wasn't until 1963 and 1964, however, that the first CVM study was published. These articles were the result of a PhD dissertation from Harvard university by Robert K. Davis on recreation in the backwoods of Maine. This method was then adapted for use in measuring air quality benefits from reduced particulate matter (Ridker, 1967). Soon afterwards, the contingent valuation method was applied to various recreation, hunting, air quality and even risk reduction for heart attacks (Hammack and Brown, 1974; Cicchetti and Smith, 1973; Darling, 1973; Eastman, Randall and Hoffer, 1974; Acton, 1973).

Most of these early studies were experimental, and it wasn't until 1979 that the CVM was given formal acceptance from the Water Resources Council (Federal Register, 1979; Water Resource Council, 1983).

In 1986, the U.S. Department of Interior recommended CVM for valuing natural resource damages (U.S. Department of Interior, 1986), the Federal courts upheld this decision (U.S. District Court of Appeals, 1989). Recently, a "blue ribbon panel" including two Nobel laureate economists, an environmental economist and a survey research specialist concluded that CVM can produce estimates reliable enough to be the starting point for administrative and judicial determinations (Arrow et al. 1993).

Since this time, the Contingent Valuation Method has been developed in a number of different ways and has become the most commonly used nonmarket technique. Further review of the literature can be found at the beginning of each of the chapters that follow.

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Chapter 2

SPLIT VS. PAIRED SAMPLES:

THE QUESTION OF SCOPE IN WILLINGNESS TO PAY ESTIMATES

FOR THREATENED AND ENDANGERED WILDLIFE

2.1 INTRODUCTION

In the United States, economic analysis is not required to list an endangered species, but it is allowed in evaluating the critical habitat designation decisions. Given the direct management and opportunity costs associated with the preservation policy and the controversy surrounding many threatened and endangered (T&E) species, it can be important to estimate the benefits of a protection policy for the species and its habitat. Many people hold values from "passive use" with the preservation of the T&E species because of the irreversible nature of extinction.

Passive use values include existence values (utility derived from just knowing that the species exists in its natural habitat, even if no visitation is planned), and bequest values (utility currently obtained from knowing that the species and its habitat is being protected for future generations). Randall and Stoll (1983) use these values plus recreation values to define the "total economic value".

Many United States residents place passive use values on the preservation of the MSO, and these benefits can be consumed simultaneously by all citizens across the United States. Because of this, protection can be considered "public good" (Bishop and Welsh, 1992, and Kopp, 1992). Also, small individual values perceived by households across the U.S. may lead to a large aggregate amount.

Since the value associated with species protection is a public good, economists often employ nonmarket valuation techniques to estimate the benefits of protection. Of the nonmarket techniques currently available, only the contingent valuation method (CVM) is able to measure passive use values (Flores, 1996). The use of CVM has a long history within the federal government, including recommendations by the Water Resources Council (1983), Department of the Interior (1986), and a decision to uphold these recommendations by the U.S. Court of Appeals in 1989 (Case No. 86-1575). The National Oceanic and Atmospheric Administration (NOAA), under the Department of Commerce established a Blue Ribbon panel in 1993, which included two nobel laureate economists, an environmental economist, and a survey research specialist to examine the advantages and pitfalls of CVM (U.S. DOI, 1993). This method measures the willingness to pay (WTP) of survey respondents to capture the values they place on passive and direct use. The question of validity arises repeatedly in CVM estimates because the respondents are asked only to state their WTP, but do not actually pay it (Diamond and Hausman, 1994; Neill, et al., 1994; Cummings, et. al., 1995). The blue ribbon panel set up by NOAA examined the questions of validity, which include inconsistency with rational choice, implausibility of responses, the absence of a meaningful budget constraint, information provision and acceptance, and "warm glow" effects.

The NOAA panel addressed the sources of potential bias inherent in CVM studies, then made recommendations that help to eliminate these sources. The resulting report endorsed the use of CVM, with suggestions for the design and implementation of the technique (U.S. DOI, 1993).

2.2 PURPOSE

The emphasis is on the NOAA panel's first validity issue, inconsistency with rational choice. The question is one of scope between the one species, the Mexican Spotted Owl (MSO), as a subset of 62 regional T&E species (also known as embedding or nesting effects since both WTP questions were asked in each survey) . Economic theory suggests that if an individual is willing to pay some amount of money to protect one species, then the individual should be willing to pay more for the protection of additional species. The survey incorporated a split sample design using the dichotomous choice format recommended by the NOAA panel. The objective of this paper is to perform scope tests using both split samples and paired responses from surveys containing two WTP questions.

This paper uses a CVM study which measured WTP for the continued protection of the CHUs for the MSO and for 62 threatened and endangered species (one of which is the MSO) in the four corners region. Two treatments were sent out that were essentially identical except for the ordering of the WTP question sections. In treatment one, the MSO was the first WTP question; treatment two had the 62 species as the first WTP question.

There have been studies conducted recently that do examine the issue of scope or embeddedness. Among these studies are Desvouges, et. al. (1992) with their marginal sensitivity analysis of migratory waterfowl WTP, and Loomis, et.al. (1993), which investigated protection of forests in southeastern Australia. They found small differences in goods when compared with a study by Kahneman and Knetsch (1992). Since then, V.K. Smith performed a META analysis approach to looking at the issue of scope using viability in U.S. National Parks. A comparison of these studies shows mixed results when looking for scope or embedding effects. These studies all have one thing in common: they used split sample data in their investigation.

Two methods are employed to test for this bias: a scope test using individual split sample probit estimations, and a paired response bivariate probit model using the WTP responses for the MSO and the 62 T&E species simultaneously.

2.3 METHODS

The procedures in this paper require different sample structures. In the first scope test, the WTP responses for the MSO are taken from the first treatment sample, where the MSO is the first WTP question, and the responses for the 62 species are taken from the second treatment sample, where the 62 species is the first WTP question.

The null and alternative hypotheses for the split samples are:

$$\begin{aligned} H_0: WTP_{MSO}^j &= WTP_{62species}^k \\ H_A: WTP_{MSO}^j &< WTP_{62species}^k \end{aligned} \quad (2.1)$$

where $j \neq k$

This is different from the bivariate probit model where both WTP responses are used from both samples, with the treatment samples separated from one another. Such a paired response bivariate probit model was used by Poe, Welsh and Champ (1997), and will be used here as well. In cases where the respondents are asked multiple WTP questions, the disturbances from the estimation models are often highly correlated, leading to biased variances and inefficient coefficient estimates. In the case of WTP questions asking about a comprehensive good, and a subset of the comprehensive good, the correlation (ρ) is expected to be positive, as opposed to compliment goods, in which a negative correlation is expected. A full information, maximum likelihood estimation procedure that takes this correlation into account can be estimated using a bivariate probit model.

The null and alternative hypotheses are:

$$\begin{aligned} H_0: \rho &= 0 \\ H_A: \rho &\neq 0 \end{aligned} \quad (2.2)$$

and

$$\begin{aligned} H_0: WTP_{MSO}^n &= WTP_{62species}^n \\ H_A: WTP_{MSO}^n &< WTP_{62species}^n \end{aligned} \quad (2.3)$$

The bivariate probit model is used here because both WTP questions are asked in the two survey treatments. Correlation of the error terms in the WTP models could exist if the responses are not independent of one another (Poe, Welsh, and Champ, 1996). If the error terms are correlated from the individual WTP models, then the variances on the mean WTP will be biased, leading to inefficiency. This problem should not occur in the split sample design case, because the data comes from two different samples. However, if the responses within the two treatments are not independent, using a bivariate probit technique to model the responses may be the appropriate specification in this case. To test the null hypothesis (2.1) and (2.3), confidence intervals around WTP amounts for MSO and the 62 species are compared. If the 95% confidence intervals do not overlap, null hypotheses (2.1) and (2.3) will be rejected.

For the split sample scope test, the two WTP questions were regressed against the bid amounts and socioeconomic variables using a probit model as shown in equation (2.4).

$$P(Y=1 | x_i) = \Phi(\beta'x) \quad (2.4)$$

where $\Phi(\beta'x)$ is the standard normal cumulative distribution.

The probit estimation technique is used here because it allows for negative WTP responses. This is important because both costs and benefits of the CHU designation were outlined in the survey. Many respondents may have an adverse reaction to the CHUs as they restrict resource extraction and increase taxes, which was the payment vehicle. These people would theoretically have to be compensated to bring their utility back to the pre-CHU designation levels.

The results of the binomial probit model can be tested for goodness of fit with the ratio of the predicted and actual responses, and from the likelihood ratio index (LRI). LRI uses the log likelihood functions from the full model used in this analysis, and from the restricted model where all coefficients are zero. The LRI is often referred to the pseudo R² statistic, and can be interpreted in a similar fashion.

$$LRI = 1 - \frac{LL_U}{LL_R} \quad (2.5)$$

The next fit measurement, the chi-squared statistic is analogous to the F-statistic, which tests the null hypothesis that all of the coefficients (except the constant term) are equal to zero. This statistic is then tested using a chi-squared distribution:

$$c = -2(LL_R - LL_U) \quad (2.6)$$

The paired response model also tests for scope, but uses the bivariate probit model to allow for correlation between responses within each respondent.

$$z_{i1} = \beta'_1 x_{i1} + \varepsilon_{i1} \quad (2.7)$$

$$z_{i2} = \beta'_3 x_{i2} + \varepsilon_{i2} \quad (2.8)$$

$$cov[\varepsilon_1, \varepsilon_2] = \rho \quad (2.9)$$

$y_{ik} = 1$ if $z_{ik} > 1$ and $y_{ik} = 0$ otherwise

For $k = 1, 2$ (depicting response per individual) and i is equal to the number of individuals.

If there is no disturbance correlation present, then the bivariate probit model is reduced down to individual probit models.

To test the null hypothesis (2.2), the log likelihood functions are compared using a standard likelihood ratio test as in equation (2.10):

$$-2(LL_{MSO} + LL_{62species} - LL_{bvar}) \sim \chi^2 \quad (2.10)$$

where LL is the log likelihood and *MSO* and *62species* represent the independent probit estimates. The *bvar* subscript represents the log likelihood function from the bivariate probit. These are compared to a chi-squared distribution test statistic to either reject or not reject the null hypothesis of $\rho = 0$ (Greene, 1993). These test results can be confirmed by using a standard t-test on the coefficient of ρ .

In both cases, the mean WTPs are estimated using a ‘grand constant’, which is calculated by multiplying the coefficients by the variable mean, dividing by the average bid amount, then summing over all coefficients (the error term is not included). The grand constant is then divided by the coefficient on the bid term (β_1) to form the mean WTP:

$$WTP = \beta_0 + \left(\sum_{i=2}^5 \beta_i \bar{x}_i \right) * \frac{1}{\beta_1} \quad (2.11)$$

Results from the probit models were used to generate confidence intervals by a technique developed by Park, Loomis and Creel (1991) that makes 4,000 draws of the coefficients using the variance-covariance matrix then calculates the mean WTP distributions. The two simulated WTP distributions are then compared to see if they overlap. Theory suggests that they should not overlap as the MSO is a subset of the 62 species.

However, given that the 62 species are all different, including 39 species of plants, they may not be considered equal. Also, the protection of one species may benefit others. Therefore, the WTP for the MSO is not expected to be 1/62 of the WTP for the 62 species.

The results from the first test will determine if the respondent differentiated between the values of the MSO and the entire group of species in the surveys. The second test will determine if the responses are correlated within the surveys.

2.4 THE SURVEY

In April of 1993, the Mexican spotted owl (*Strix Occidentalis Lucida*) was listed by the U.S. Fish and Wildlife Service as a threatened species. In 1995, the U.S. Fish and Wildlife Service designated 4.6 million acres of critical habitat units (CHUs) for the Mexican spotted owl in the "four corners" region of the United States (Southern Utah, Southeastern Colorado, Western New Mexico, and Arizona). The listing of the MSO severely restricted logging of old growth forests in the four corners region, but unlike the Northern Spotted owl, the net benefits of foregone timber harvesting are relatively minimal because of the below-cost timber sales common in the region. The major costs associated with the protection policy are the recovery efforts. The U.S. Fish and Wildlife Service estimates the recovery costs over the next ten years will include \$260,000 to amend federal resource management plans, \$19.8 million for monitoring, \$8.3 million for related research and \$10.1 million for other features. This leads to an average of \$4 million a year for the next ten years, and if successful, will result in the delisting of the species in 15 years (U.S. DOI, 1995).

Most of the recommendations made by the NOAA panel were incorporated into the survey which elicited WTP responses. A few were left out because of time and budget constraints, the most notable being the use of mail surveys instead of in-person interviews. The recommendation of a dichotomous choice referenda format, with varying dollar amounts across respondents was followed. Respondents "voted" yes or no to a given specific dollar (bid) amount.

After several focus groups and nation-wide pretesting, two almost identical survey treatments were used. Detailed maps of both the MSO and the 62 species CHUs were given to all respondents. The maps included a locator map and different shaded areas indicating where the CHUs. Federal/Tribal land, large cities, and major rivers are. Other questions in the survey included knowledge about T&E species in the region, likert-scale opinion questions about management issues, an area for protest votes, and a variety of socioeconomic questions.

One sample received a treatment which asked about the MSO as the first WTP question, and WTP for the 62 T&E species as the second. The other sample was given a treatment which reversed the order of the WTP questions. The two questions are as follows:

1. If the Mexican Spotted Owl Recovery Federal Trust Fund was the only issue on the next ballot and would cost your household \$___ every year, would you vote in favor of it? (Please circle one.)

YES

NO

2. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$___ every year, would you vote in favor of it?

YES

NO

The bid amounts varied from \$1 to \$350 for both samples. Fourteen bid amounts were used, \$1, 3, 5, 10, 20, 15, 30, 40, 50, 75, 100, 150, 200, and 350. The bid amounts were based on a number of focus groups, pretests, and past Spotted Owl CVM studies. The bid amounts were systematically assigned to each respondent, and each individual received the same bid amount for both WTP questions in a given survey.

On the pages following both WTP questions, there was an area provided for respondents to describe their protests if they voted NO to the question. Seven anticipated responses were listed, along with an 'Other, please explain:' response, however, all responses were used in the analysis, even the protests.

Both samples were drawn systematically with half of the sample for each survey treatment taken from the Four-corners region, and the other half from the rest of the United States.¹ The samples were structured this way in order to give policy makers significant regional results. A total of 1600 surveys were sent out, 800 for each treatment. A total of 754 surveys were returned (385 from treatment one and 369 from treatment two), which leads to a 54.44% response rate when the undeliverable surveys are excluded. While this response rate was not as high as the NOAA panel suggested for natural resource damage assessment court cases, it is higher than many mail surveys of the general public (Loomis, 1981). We will also be conservative and generalize our WTP only to the proportion of the population responding.

2.5 RESULTS

In the estimation of WTP, the five most significant variables were: Bid, TEknow, Age, Protect, and Projob. The dependent variable was either **Owlpay** or **TEpay**, for the MSO and the 62 species respectively, which was coded as 1 if the respondent was willing to pay the bid amount (**Bid**), and 0 if not. **Age** is the respondents age in years. **TEknow** is the summation of the responses to three knowledge questions, again the responses were coded as 1 for yes, and 0 for no.² **Protect** and **Projob** are the combination of opinion questions dealing with species protection and resource extraction respectively.³

Table 2.1
Split Sample Probit Models

Variable	Mexican Spotted Owl (sample 1)			62 T&E Species (sample 2)		
	Coefficient	t-statistic	Elasticities	Coefficient	t-statistic	Elasticities
Constant	0.284	0.568		1.018	2.040	
Bid	-0.006	-6.068	-0.063	-0.006	-5.917	-0.047
TEknow	0.209	2.64	0.130	0.105	1.261	0.110
Age	-0.005	-1.157	-0.207	-0.015	-2.865	-0.182
Protect	0.257	6.015	0.176	0.294	6.795	0.149
Projob	-0.166	-3.720	-0.256	-0.253	-5.518	-0.207
Number of Obs.	352			340		
Log Likelihood	-175.653			-146.042		
Restricted Log Likelihood	-243.027			-232.271		
Likelihood Ratio Index	0.277			0.371		
Chi-squared	134.748			172.456		
Mean WTP	\$48.01			\$117.84		
95% C. I.	\$18.49 - \$75.01			\$87.37 - \$159.23		

Table 2.1 shows the results of the split sample probit models. The coefficients indicate the following (*ceteris paribus*): β_1 (Bid) is negative, indicating that the probability of a YES response goes down as the bid amount increases; β_2 (TEknow) is positive meaning that the more knowledge the respondent has about threatened and endangered species, the more likely they are to pay for protection; β_3 (Age) shows the probability of WTP goes down for older respondents; β_4 (Protect) and β_5 (Projob) are positive and negative respectively, indicating that the probability of a yes response for the WTP question is larger for respondents in agreement with species protection, and smaller for respondents in agreement with jobs/resource extraction. The coefficients in Table 2.2 and Table 2.3 all have the same signs, so the interpretation of the coefficients are similar. Elasticities were also calculated for the split sample models. In both the MSO and 62 species cases, WTP is most responsive to the variables projob, age and protect in that order.

The split sample confidence intervals around the mean WTP does pass the scope test at the 95% confidence level.⁴ In other words, it could be shown that the mean WTP from the two goods were significantly different from one another for the split sample. Null hypothesis (2.1) is therefore rejected. Testing for correlation in the responses via the paired response model is done using the likelihood ratio test and the t-statistic on ρ . From equation (2.10), the likelihood ratio tests yield a results of 221.194 for sample 1 and 171.0606 for sample 2, which is compared to the chi-squared test statistic of $\chi^2_{1,0.05} = 3.84$. This indicates the presence of disturbance correlation in a given respondents answer to both questions, so the null hypothesis is rejected in both cases.

These results are confirmed by the significant t-statistics on ρ as shown in Tables 2.2 and 2.3. Confidence intervals outlined in Tables 2 and 3 indicate no significant difference in the WTP for the two programs. The null hypothesis (2.3) should not be rejected, the WTP in paired response model does not pass the scope test.

The key difference between the split sample probit and the bivariate probit models lies in the mean WTP and the confidence intervals. The range of values for the MSO are very similar for the first sample, regardless of modeling technique, but unlike the split sample probit model, the scope test does not pass at the 95 or 90% confidence level for the bivariate probit model. It appears that the valuation of the single species first may have pulled down the WTP value of the 62 T&E species.

Table 2.2
Bivariate Probit Model For Sample 1

Variable	Mexican Spotted Owl		62 T&E Species	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.308	0.592	0.012	0.023
Bid	-0.006	-7.282	-0.006	-7.667
TEknow	0.218	2.429	0.272	3.005
Age	-0.006	-1.106	-0.006	-1.084
Protect	0.259	6.973	0.263	6.615
Projob	-0.166	-3.484	-0.204	-4.211
ρ	0.975	73.136		
Number of Obs.	348			
Log Likelihood	-234.859			
Mean WTP	50.494		59.516	
95% Confidence Interval	21.983 - 75.141		30.021 - 85.745	

Table 2.3
Bivariate Probit Model For Sample 2

Variable	62 T&E Species		Mexican Spotted Owl	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.961	1.636	0.252	0.503
Bid	-0.006	-5.566	-0.005	-5.496
TEknow	0.073	0.806	0.108	1.366
Age	-0.013	-2.105	-0.008	-1.678
Protect	0.288	5.386	0.266	6.161
Projob	-0.245	-4.377	-0.247	-5.365
ρ	0.974			40.805
Number of Obs.	338			
Log Likelihood	-221.8217			
Mean WTP	87.521		63.783	
95% Confidence Interval	55.798 - 124.29		20.953 - 104.66	

2.6 BENEFIT-COST COMPARISON

Table 2.4 presents a sensitivity analysis of the benefits and costs of protecting the Mexican Spotted Owl. All three sample estimates are used. To be conservative, we generalized our sample results only to the proportion of households that responded to our study, assuming a zero WTP for non-responding households. Table 2.4 shows that regardless of which of the 3 WTP estimates are used, benefits exceed costs.

Table 2.4
Benefit and Cost Comparison for Protecting the Mexican Spotted Owl

	Split Sample	Paired Response Sample 1	Paired Response Sample 2
Benefits	\$ 2.4 Billion	\$2.5 Billion	\$3.2 Billion
Costs	\$4 Million	\$4 Million	\$4 Million

The figures for this table are calculated based on the 91,993,582 households in the United States, and assuming that 44.6% of the population (the percentage of nonrespondents) have a WTP of zero. The remaining 55.4% of the population has a mean WTP as indicated in Tables 2.1, 2.2 and 2.3. The costs shown in Table 4 are taken from the Economic Analysis of Critical Habitat Designation for the Mexican Spotted Owl report to the U.S. Fish and Wildlife Service (Ekstrand, et al. 1995). They reflect the costs of the recovery efforts, including amending federal resource management plans, monitoring MSO populations, related research, and other features of the recovery plan.

2.7 CONCLUSIONS

The estimation results from a split sample frame suggest the null hypothesis of $WTP_{MSO} = WTP_{62species}$ can be rejected. This coincides with economic theory that WTP for a comprehensive good should be significantly different (greater than) the WTP for a subset of that good. When individuals respond to both programs together with the use of a bivariate probit model, there is evidence that the error terms are correlated, and despite accounting for this, the confidence intervals around the WTP estimates overlap.

This would indicate weak, if any differentiation between the WTP for the MSO and the 62 species within each sample. These results contradicts with the NOAA panel view that the survey respondents force good differentiation when faced with the two goods in one survey.

The question of which method of estimation for WTP is not totally clear, there is need for further study. The NOAA panel suggests the use of a split sample, but perhaps more tests of validity should be recommended in order to provide a more complete analysis. As shown in this paper, one test may contradict another, weakening the results. On the other hand, if both test are in agreement, one could better argue the validity of their policy implications.

The next obvious step is to look at the potential for sequencing bias (Boyle, Welsh and Bishop, 1993, and Carson and Mitchell, 1995). The split sample technique employed in this study does side-step the occurrence of sequencing bias by using only the first WTP question in both treatments, but the does not preclude the existence of bias.

ENDNOTES

1. The services of Survey Sampling in Fairfield, CT were employed to get the most random sample possible. The resulting data were tested for regional differences among respondents. No significant differences were found.
2. i) Have you read or heard of the Northern Spotted Owl in the Northwestern United States?;
ii) Have you read or hear of the Mexican Spotted Owl in the Southwestern United States?; and
iii) Have you read or heard about threatened and endangered fish species in the Colorado River?
3. We asked six likert-scale questions were asked on a scale of 1 to 5, with 1 being strongly agree, 3 being neutral, and 5 being strongly disagree:
i) “Businesses should be allowed to extract natural resources from Federal lands”;
ii) “All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being”;
iii) “Plants and animals have as much right as humans to exist”;
iv) “I am glad that the endangered species in the Four Corners Region are protected even if I never see them”;
v) “If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large”; and
vi) “Protection of Threatened and Endangered Species is a responsibility I am willing to pay for”.
Questions i) and v) were added together and multiplied by -1 to form PROJOB.
Questions ii), iii), iv), and vi) were added together and multiplied by -1/2 to form PROTECT.
4. These same regressions were run using a logit model. The logit model passed the scope test at the 90% confidence interval, with mean WTP \$100.75 and \$197.43 for the MSO and 62 species respectively. More information is available from the authors upon request.

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Chapter 3

TWO VALUATION QUESTIONS IN ONE SURVEY:

IS IT A RECIPE FOR SEQUENCING AND INSTRUMENT CONTEXT EFFECTS?

3.1 INTRODUCTION

The economic value of threatened and endangered species protection is difficult to estimate, and estimates are often controversial. Protection policies of these species are pure public goods and cannot be efficiently traded in an open market. To complicate matters, individuals commonly place “passive use” values on protection policies, making revealed preference techniques difficult or impossible to employ. Passive use values include *existence values* (utility derived from just knowing that the species exist in their natural habitat), and *bequest values* (utility obtained presently from knowing that species and their habitat are being protected for future generations). These values plus *direct use values* (such as recreation) are defined as “total economic value” by Randall and Stoll (1983). Passive use values can be very widely spread because species protection is considered a public good as it can be consumed simultaneously by all citizens across the United States (Bishop and Welsh, 1992. and Kopp, 1992).

Currently, the contingent valuation method (CVM) is the only method to measure passive use values (Flores, 1996), and the Endangered Species Act requires an economic analysis in order to designate critical habitat units (CHUs). Resource managers often use CVM to estimate direct and passive use values for threatened and endangered species. Due to budget constraints and the desire to include substitute resources in valuation, many CVM surveys contain more than one willingness to pay (WTP) question. While this may be cost effective, question ordering and instrument context often become issues when more than one valuation question is present.

This paper looks at 1) sequencing effects and 2) instrument context effects using a dichotomous choice, CVM survey of passive use goods. Two WTP questions were asked in each survey, WTP for a comprehensive good, and WTP for one of two different embedded goods. The question ordering also varied, leading to four distinct treatments of the survey (see Table 1). The comprehensive good is 62 threatened and endangered species that reside in the Four-Corners Region of the United States (Southern Utah, Southeastern Colorado, Western New Mexico, and Arizona). The embedded goods are two subsets of the comprehensive good, the Mexican spotted owl, and 9 threatened and endangered (T&E) fish species.

Table 3.1
Differences in Survey Treatments

Context:	Ordering:	
	Embedded Good First	Comprehensive Good First
Embedded Good A (Mexican Spotted Owl)	Treatment #1	Treatment #2
Embedded Good B (9 Fish Species)	Treatment #3	Treatment #4

3.2 THEORETICAL FRAMEWORK

If question ordering effects respondents' WTP decisions, there are "sequencing effects" inherent in their answers (Carson and Mitchell, 1995). If the respondent is told to value each a program independently, the sequence of questions should have little or no effect on WTP responses of a rational individual. Conversely, Kahneman and Knetsch (1992) suggest that the responses to the valuation questions may serve as a source of moral satisfaction and not a measure of the good in question. Therefore, subsequent questions would yield smaller WTP amounts because the sense of moral satisfaction has been fulfilled by the first WTP question. It is also possible that the respondent cannot forget about the first program shown, when asked to value the second program, independent of the first. Income and substitution effects may come into play if the respondent believes their answer to the first program may bring about provision of that good. They would have to pay (income effect), and this first good may be a substitute in the utility function for the second good. Sequencing effects in the case of contingent valuation WTP estimates has been examined by others (Boyle, Welsh and Bishop, 1993, and Carson and Mitchell, 1995), but little study has been done on the issue of *instrument context* (Mitchell and Carson, 1989).

When dealing with a survey containing multiple questions, does the content of a preceding question influence the responses to following questions? Ideally, if told to value each good as if it were the only one they are deciding on, then the order or context of the bundle should not matter. That is, if $A \succ C$ in set A, B, C , then we should observe $A \succ C$ in set C, B, A and in set C, D, A .

If this is not the case, the respondent exhibits “instrument context effects”. Mitchell and Carson (1993) suggest that if both the comprehensive and embedded goods are explained, perhaps with the use of maps or other clarifying tools, these effects can be minimized. Combining sequencing with context effects may compound the potential for bias.

Respondent sensitivity to these effects can be problematic if the programs being valued are similar, or one element is believed by the respondent to serve as an indicator for another. In our survey, the critical habitat units (CHUs) for the Mexican spotted owl differ from the 62 threatened and endangered species by 2456 miles of river segments and the type of land. For example, the owl required old growth forests, while cactus grows in the desert. If respondents assume that protection of one species will provide adequate protection for many other species in the ecosystem, then the distinction between programs may be blurred. This may be the case for a few of the species in our group, but not all. The survey made clear that the Mexican spotted owl depends on old growth forest. The broader group of species to be protected included fifteen fish and ten cactus, so we believe the differences between the two programs should be fairly clear.

Another issue relates to the problem that the respondent may see the two programs and their costs as additive.. We specifically told the respondents to value each program independently, but it is difficult to factor out income and substitution effects between the programs when two programs appear in one survey. This may be especially true in a mail survey where the respondent can see both programs before answering either one.

3.3 METHODS

For the analysis, dichotomous choice WTP responses (y_i) can be regressed against a constant, the bid amount, and a vector of socioeconomic variables ($X'\beta$) using a traditional logistic function (Hannemann, 1984):

$$y_i = \frac{\exp(X'\beta)}{[1 + \exp(X'\beta)]} \quad (3.1)$$

The logistic function estimates the probability that an individual is willing to pay for a good given a bid amount and a set of socioeconomic characteristics. The variable y_i is binomial, taking on a value of 1 for a 'yes' response, and 0 for a 'no' response. In estimating this function, the probability of a 'yes' response can be modeled for varying bid amounts (dollar values).

The results of the binomial logit model can be evaluated for goodness of fit with the likelihood ratio index (LRI). The LRI uses the log likelihood functions from the full model used in this analysis (LL_U), and from the restricted model where all coefficients are zero (LL_R). The LRI is often referred to the pseudo R^2 , and can be interpreted in a similar fashion to R^2 statistic. The LRI is bounded between zero and one, however, it does not give the percent of explanatory power like the R^2 statistic does.

$$LRI = 1 - \frac{LL_U}{LL_R} \quad (3.2)$$

The next goodness of fit measure, the chi-squared statistic, is analogous to the F-statistic, which tests the null hypothesis that all of the coefficients are equal to zero. This statistic is then tested using a chi-squared distribution:

$$x^2_{\text{calculated}} = -2(LL_R - LL_t) \quad (3.3)$$

Mean and median WTPs are calculated using regression coefficients ($\beta_2 - \beta_5$), the constant term (β_0), and the bid term (β_1). The restricted mean willingness to pay is calculated using a formula from Hannemann (1989). This formula restricts the WTP to the nonnegative region in order to avoid double counting costs:

$$\text{Restricted Mean WTP} = \frac{\ln(1 + e^{\beta_0 - \sum_{i=2}^5 \beta_i \bar{x}_i})}{|\beta_1|} \quad (3.4)$$

$$\text{Unrestricted Mean WTP} = \frac{(\beta_0 + \sum_{i=2}^5 \beta_i \bar{x}_i)}{|\beta_1|} \quad (3.5)$$

The coefficients from the logit function are then used to generate confidence intervals by a method developed by Park, Loomis and Creel (1991) which makes 4,000 draws of the coefficients using the variance-covariance matrix. A moderate level of significance (5% instead of 1%) is desired because it leads to smaller ranges for the confidence intervals, avoiding the occurrence of a Type II error (accepting an incorrect null hypothesis).

3.3.1 Sequencing Effects

In order to test for the effects of different question ordering or sequencing, the basic logit model is expanded to incorporate a dummy variable for the survey treatment. In this case, if the embedded good is first in the sequence (as in treatments 1 and 3), the dummy variable (*Order*) takes on a value of 1. If the comprehensive good appears first, the variable equals 0. Equation (1) is therefore augmented to account for different question ordering:

$$y_{ij} = \frac{\exp(X' \beta + \alpha Order_j)}{[1 + \exp(X' \beta + \alpha Order_j)]} \quad (3.6)$$

where i is the observation number, and $j = 1, 2$ for embedded good A or B respectively.

The t-statistic of the coefficient on *Order* can indicate with some level of confidence, whether or not to reject the null hypothesis that question ordering is not a significant factor in determining the probability of WTP:

$$H_0: \alpha = 0 \quad (3.7a)$$

$$H_A: \alpha \neq 0 \quad (3.7b)$$

This test is performed twice, once with the results of treatments 1 and 2 (embedded good A), and again with results from treatments 3 and 4 (embedded good B).

To test for the possibility that order influences the slope coefficients, a likelihood ratio test (LRT) is performed.

$$\begin{aligned} H_0: \beta_1^{1''} &= \beta_1^{2''}, \beta_2^{1''} = \beta_2^{2''}, \dots, \beta_k^{1''} = \beta_k^{2''} \\ H_A: \beta_1^{1''} &\neq \beta_1^{2''}, \beta_2^{1''} \neq \beta_2^{2''}, \dots, \beta_k^{1''} \neq \beta_k^{2''} \end{aligned} \quad (3.8)$$

where 1st or 2nd is if the good g (embedded good or 62 species) is offered first or second, and k is the coefficient number (0...5).

The Likelihood Ratio Test is as follows:

$$-2[LL_{combined} - (LL_{1^{st}} + LL_{2^{nd}})] \sim \chi^2_{k-1} \quad (3.9)$$

This test examines the possibility that the location and scale of the parameter distributions may be different among the various survey samples.

3.3.2 Instrument Context Effects

To test for instrument context effects, the WTP for the comprehensive good will be taken from the separate treatments that solicit WTP for the embedded goods first (treatments 1 and 3). From these two survey treatments, two logit models are estimated, and confidence intervals are constructed around the mean WTPs of the comprehensive good. The confidence intervals are then compared against each other to see if the WTPs are statistically different. The null and alternative hypothesis are as follows:

$$\begin{aligned} H_0: WTP_m &= WTP_n \\ H_A: WTP_m &\neq WTP_n \end{aligned} \quad (3.10)$$

Where m represents WTP for the 62 species when preceded by the Mexican spotted owl question, and n is WTP for the 62 species when preceded by the 9 endangered fish species question.

Confidence intervals around the means of the socioeconomic characteristics are constructed to test whether the sample sets are significantly different from one another or not. If the confidence intervals on the socioeconomic characteristics are the same, any differences in the WTP estimates are due to context effects, i.e. treatment, not sample characteristics, are the source of the effects. If the confidence intervals do not overlap, the WTP estimates can be interpreted to reject the null hypothesis (10). The confidence intervals are constructed as follows:

$$Prob \left[\bar{x} - \frac{1.96 \sigma_x}{\sqrt{n}} < \mu_x < \bar{x} + \frac{1.96 \sigma_x}{\sqrt{n}} \right] = 0.95 \quad (3.11)$$

where σ_x is the standard deviation of the sample variable x , n is the number of observations, and μ_x is the true mean of x .

3.4 THE SURVEY

Like the Northern spotted owl (*Strix Occedentralis Caurina*), the Mexican spotted owl (*Strix Occedentralis Lucida*) is listed by the U.S. Fish and Wildlife Service on the Threatened and Endangered Species list. Also like his Northern relative, the Mexican spotted owl (MSO) is protected by a policy that restricts the extraction of resources from designated “Critical Habitat Units” (CHUs). The CHUs are located in the Four-Corners region of the United States. This region also supports nine protected threatened and endangered fish species which are listed by the Fish and Wildlife Service.³

In total, there are 62 threatened and endangered species that live exclusively in this region. The designated CHUs of the Mexican spotted owl extend over 4.6 million acres, and 2,456 miles of river for the nine T&E fish, with the vast majority of the area contained on federal land.

The survey was developed using focus groups in three out of the four states, and nation-wide pretesting. All surveys contained a brief description of the species in question, including species classification, lists of costs and benefits of protection, and a map of the region, highlighting Federal and Tribal Land, and location of CHUs. Prior to the WTP questions, general opinion questions regarding views on resource jobs/resource extraction and species protection were asked in a likert-scale format. Respondents were given the opportunity to voice protests if they responded “NO” to any WTP question, but all responses were used in this analysis. Finally, with a group of socioeconomic questions, the surveys concluded.

The four survey treatments were almost identical, all contained a WTP question for the 62 threatened and endangered species protection (referred to as the comprehensive good). The surveys also contained a WTP question for an embedded set of those species; half pertaining to the protection of the MSO (good A), and half pertaining to the 9 fish species (good B). The treatments were further broken down into two more groups, one which solicited responses for the 62 species first, the other group asked about the subset of species first (see Table 1).

The survey was constructed to follow as closely as possible, the recommendations set forth by the National Oceanic and Atmospheric Administration's "blue-ribbon" panel on contingent valuation (U.S. DOC, 1995), and by Mitchell and Carson (1993). The most important exception to these recommendations in our study was the use of mail surveys rather than in-person interviews, and as one reviewer has pointed out, this can complicate the issues being addresses as the respondent has the opportunity to view the entire survey before answering. The WTP questions were presented in a dichotomous choice referendum format. Respondents received either questions 1 and 3, or questions 2 and 3. The specific wording of the three questions is:

1. If the Mexican Spotted Owl Recovery Federal Trust Fund was the only issue on the next ballot and would cost your household \$___ every year, would you vote in favor of it?

YES NO

2. If the Four Corners Region Threatened and Endangered Fish Trust Fund was the only issue on the next ballot and it would cost your household \$___ every year, would you vote in favor of it?

YES NO

3. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$___ every year, would you vote in favor of it?

YES NO

Bid amount varied from \$1 to \$350 for all three questions, and both questions in a single survey received the same bid amount.⁶

The sample was systematically drawn with half of the surveys sent to residents in the Four-Corners states, and half to the rest of the United States.⁷ In total, 3200 surveys were distributed, 800 for each treatment, and there was random assignment of survey treatments to addresses. For treatments 1 and 2, a total of 754 surveys were returned (385 from treatment 1 and 369 from treatment 2), which leads to a 54.44% response rate when undeliverable surveys are excluded. For treatments 3 and 4, a total of 721 surveys were returned (388 and 333 respectively), leading to a 52.23% response rate when adjusted for undeliverables. Thus the response rates were quite comparable among the treatments, which is the most important issue for our methodological comparison. Undeliverable survey returned with forwarding addresses were relabeled and resent. Nonetheless, the omission of those undeliverables without forwarding addresses are under-represented in our survey results.

3.5 RESULTS

In the estimation of WTP, five variables were the most significant: **Bid**, **TEknow**, **Age**, **Protect**, and **Projob**. The dependent variable was either **Owlpay**, **Fishpay** or **TEpay**, for the MSO, 9 fish, and the 62 species respectively which was coded as 1 if the respondent was willing to pay the bid amount (**Bid**), and 0 if not. **Age** is the respondents age in years. **TEknow** is the summation of the responses to three knowledge questions, again the responses were coded as 1 for yes, and 0 for no.⁸ **Protect** and **Projob** are the combination of opinion questions dealing with species protection and resource extraction respectively.⁹

This question was designed to reflect differences in respondent tastes and preferences.

3.5.1 Statistical Results

In all of the models shown in Tables 3.2 and 3.3, the coefficients indicate the following (holding everything else constant): β_1 (Bid) is negative, the probability of paying goes down as the bid amount increases; β_2 (TEknow) is positive meaning that the more knowledge the respondent has about threatened and endangered species, the more likely they are to pay for protection; β_3 (Age) shows the probability of paying goes down for older respondents; β_4 (Protect) and β_5 (Projob) are positive and negative respectively, indicating that the probability of a yes response for the WTP question is larger for respondents in agreement with species protection, and smaller for respondents in agreement with jobs/resource extraction.

All of the models were tested for overall significance using the chi-squared statistic defined in Equation (3.3). All of the models indicated significance when compared to the chi-squared test statistic of $\chi^2_{1,0.05} = 3.84$. The LRI defined in Equation (3.2) is also known as the pseudo R^2 . The statistic ranged from 0.227 to 0.338, suggesting a reasonable fit for the cross-sectional individual level data.

3.5.2 Results of Hypothesis Tests

Tables 3.2 and 3.3 examine the possibility of sequencing effects existing in the surveys. Table 3.2 looks at this possibility of sequencing effects for the 62 species and MSO case.

Because a Type II error (accepting a false null hypothesis) should be avoided if possible, a 5% (rather than 1%) level of significance is selected to test the null hypothesis (3.7). At the 5% level of significance, the critical t-statistic for a two tailed test is 1.96 with our sample size. Only the second calculated t-statistics from Table 3.2 (for the 62 species) leads to a rejection of the null hypothesis. It appears that there is some measure of sequencing effects present in the responses for treatments 1 and 2. The coefficient on the dummy variable, *Order*, is negative in both cases, and significant in the 62 species question.¹⁰ The negative dummy variable in the second regression in Table 3.2 shows that WTP for the 62 species is less when the MSO WTP question appears first in the survey.

Table 3.2
Test for Sequencing Effects
Mexican Spotted Owl and 62 Species

Variable	Mexican Spotted Owl		62 T&E Species	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.691	1.164	1.300	2.104
Bid	-0.010	-7.537	-0.010	-7.926
TEknow	0.265	2.767	0.302	3.026
Age	-0.012	-2.008	-0.016	-2.720
Protect	0.441	8.422	0.482	8.843
Projob	-0.338	-6.277	-0.384	-6.872
Order	-0.332	-1.738	-0.767	-3.803
Number of Obs.	691		691	
LRI	0.294		0.338	
Chi-squared	281.684		323.768	
LRT	4.462		5.515	
Restricted Mean WTP	\$102.15		\$117.69	
Unrestricted Mean WTP	\$53.39		\$81.71	
95% Confidence Interval of Mean WTP	\$85.09 - \$128.83		\$99.46 - \$146.77	

Table 3.3
 Test for Sequencing Effects
 9 Threatened & Endangered Fish and 62 Species

Variable	9 Endangered Fish Species		62 T&E Species	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	1.370	2.243	1.386	2.257
Bid	-0.006	-5.231	-0.005	-5.118
TEknow	0.101	1.010	0.171	1.707
Age	-0.002	-0.386	-0.002	-0.362
Protect	0.484	9.197	0.485	9.164
Projob	-0.232	-4.417	-0.234	-4.443
Order	-0.031	-0.162	-0.144	-0.747
Number of Obs.	648		646	
LRI	0.227		0.228	
Chi-squared	213.985		212.760	
LRT	4.265		8.505	
Restricted Mean WTP	\$194.88		\$209.01	
Unrestricted Mean WTP	\$113.25		\$134.53	
95% Confidence Interval of Mean WTP	\$149.05 - \$290.46		\$160.68 - \$310.80	

In Table 3.3, the calculated t-statistics indicate the coefficients on the treatment dummy variable, *Order*, are insignificant in the 9 fishes survey. In other words, when the 62 species WTP question is accompanied by the 9 fish WTP question, the question sequence does not make a significant difference. Thus, even though the same basic survey is used, the 9 fish treatment clearly rejects an order effect while the MSO treatment there is mixed evidence, with one significant and one not significant. Therefore, the order effect may be related to the nature of the good.

The critical χ^2 statistic for the Likelihood Ratio Test on coefficient equality is 9.49 for a 95% confidence level. The calculated χ^2 statistic for the owl, the fish, and the 62 T&E species groups are lower than the critical statistic, as can be seen in Tables 3.2 and 3.3. This indicates that the location and scale of the parameter distributions are not significantly different among the survey treatments for each good. This lends support to the conclusion that there generally appears to be no order effect.

Table 3.4 compares the demographics of the two samples used in the instrument context analysis. The cross sample comparison is needed to make sure any differences are not due to sample composition. As shown in Table 3.4, the socioeconomic characteristics are not significantly different between samples.

Table 3.4
95% Confidence Intervals For
Socioeconomic Characteristics of Survey Samples

	Sample 1	Sample 2
	(MSO)	(9 fish species)
Average Age of Households	50.1 - 53.6	51.9 - 55.4
Education, 25 years and older ¹	14.2 - 14.9	14.5 - 15.1
Mean Income, for all Households	\$48854-\$55817	\$49081-\$57644
Household Size	2.38 - 2.63	2.35 - 2.64
Percentage of Males	63.5% - 73.0%	60.8% - 71.0%
Percentage of Females	26.5% - 36.0%	29.0% - 39.2%

¹Education in years, i.e. level 12 is high school, 14 is associates degree, 16 is college graduate.

Table 3.5
Test for Context Effects

Variable	62 Species accompanied by The Mexican Spotted Owl		62 Species accompanied by 9 Endangered Fish Species	
	Coefficient	t-statistic	Coefficient	t-statistic
Constant	0.149	0.168	2.121	2.708
Bid	-0.011	-5.749	-0.005	-3.539
TEknow	0.465	3.281	0.237	1.744
Age	-0.008	-1.024	-0.011	-1.328
Protect	0.478	5.955	0.571	7.635
Projob	-0.342	-4.294	-0.191	-2.880
Grand Constant	0.590		0.674	
Number of Obs.	352		366	
LRI	0.312		0.249	
Chi-squared	152.090		126.622	
Restricted Mean WTP	\$93.45		\$217.00	
Unrestricted Mean WTP	\$52.56		\$133.76	
95% Confidence	\$74.48 - \$129.60		\$145.66 - \$416.10	
Interval of Mean WTP				

As shown in Table 3.5, the test for instrument context effects using confidence intervals indicate a significant difference between the WTP for the 62 species under different programs. A significant difference is exhibited by the non-overlapping confidence intervals. This result shows evidence that instrument context effects do exist between the two survey programs. Also, mean WTP for the 62 species is over two times larger when valued in the 9 fish species survey vs. the MSO.

The median WTP, which is often preferred (because it is not as influenced by extreme responses), shows that WTP is also over two times greater for the 62 species when is accompanied by the 9 fish species.

3.6 CONCLUSIONS

This investigation of sequencing and instrument context effects shows evidence that question ordering and preceding question content may, in fact, influence responses to CVM WTP questions. The t-test on order from Table 3.2 suggests that sequencing effects can create a problem for the sample set which includes the Mexican spotted owl. This is not the case for the sample containing the 9 fish species data, as seen in Table 3.3. The different outcomes could be due to the different resources being valued and not the sequence. Although the Likelihood Ratio Tests showed no evidence of location or scale differences in the coefficients for either the Mexican Spotted Owl or 9 fish species.

The findings from the context tests show strong evidence that instrument context effects do exist in the two survey programs investigated. Given the context effects, it is important for CVM surveys to introduce only as much context as is relevant for actual policy substitution effects. Further research should test to see if the likelihood of context effects are increased by reliance on mail surveys or whether it persists using in-person interviews as recommended by the NOAA panel.

One important advantage to in-person interviews is that the interviewer can make more clear the idea that the goods are to be valued independently, not additively, and completely control for the order in which respondents see the program. The second program would not be seen until after the first program was valued.

The goods valued in this study also suffer from some similarity of habitat protection. All species introduced in this study live in the same region of the country, and while their critical habitat units are unique for each protected species (e.g. owls live in forests, cactus in deserts, fish in rivers), the areas often overlap the habitat of some other T&E species examined. It is often difficult to control for respondents assumptions that one CHU will adequately protect many other species. Thus both economic theory and ecology may suggest multi-species recovery planning and valuation rather than a single species approach if more than one ecologically related species are endangered.

ENDNOTES

5. The Bonytail Chub (*Gila Elagans*), Colorado Squawfish (*Ptychocheilus Lucius*), Humpback Chub (*Gila Cypha*), Loach Minnow (*Rhinichthys Cobitis*), Razorback Sucker (*Xyrauchen Texanus*), Rio Grande Silvery Minnow (*Hybognathus Amarus*), Spikedace (*Meda Fulgida*), Virgin River Chub (*Gila Robusta Semidnuda*), and the Woundfin (*Plagopterus Argentissimus*).
6. Fourteen bid amounts were used in equal proportions: \$1, 3, 5, 10, 20, 30, 40, 50, 75, 100, 150, 200, and 350.
7. The services of Survey Sampling in Fairfield, CT were employed to obtain a random sample.
8.
 - i) Have you read or heard of the Northern Spotted Owl in the Northwestern United States?;
 - ii) Have you read or hear of the Mexican Spotted Owl in the Southwestern United States?; and
 - iii) Have you read or heard about threatened and endangered fish species in the Colorado River?
9. Six likert-scale questions were asked on a scale of 1 to 5, with 1 being strongly agree, 3 being neutral, and 5 being strongly disagree.
 - i) Businesses should be allowed to extract natural resources from Federal lands;
 - ii) All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being;
 - iii) Plants and animals have as much right as humans to exist;
 - iv) I am glad that the endangered species in the Four Corners Region are protected even if I never see them;
 - v) If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large; and
 - vi) Protection of Threatened and Endangered Species is a responsibility I am willing to pay for.Questions i) and v) were added together and multiplied by -1 to form PROJOB. Questions ii), iii), iv), and vi) were added together and multiplied by -1/2 to form PROTECT.
10. The t-statistic on Order for the Mexican spotted owl question is significant at the 10% level. This indicates that WTP for the MSO is smaller when its WTP question appears first in the survey.

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Chapter 4

A Comparison of Parametric and Non-Parametric Modeling Techniques in Estimating Willingness to Pay: Application to Endangered Fish Species

4.1. INTRODUCTION

It is often difficult to estimate the willingness to pay for many nonmarket goods such as public goods. Indirect means, like revealed preference and hypothetical market techniques, are often employed. However, some qualities of the public goods elude even the best nonmarket estimations because they have non-use or *passive-use* characteristics (i.e. existence, option, and bequest values). To date, the only method to estimate willingness to pay for passive use values is the contingent valuation method (Flores, 1996). The contingent valuation method (CVM) is fraught with controversy over the inconsistencies of its estimates (Cummings, Harrison and Rutstrom, 1995; Diamond and Hausman, 1994; Neill, et al., 1994).

Great efforts have been made to reduce the extent of estimation inconsistencies through survey design and implementation. The Blue Ribbon panel on contingent valuation set up by NOAA (DOC, 1993) along with Mitchell and Carson (1989) have been interpreted as an industry standard for designing and implementing CVM studies.

They recommend that WTP questions be worded in a referendum format, i.e. ask the respondents if they would vote in favor of paying a given dollar amount for given good(s) or service(s). The referendum CVM was introduced by Hoehn and Randall in 1987, based from the single bounded dichotomous choice format introduced by Bishop and Heberlein in 1979.

The discrete choice responses have traditionally been modeled using logistical or cumulative normal equations known as logit and probit, respectively. Mean WTP estimates are constructed from the distribution described by the logit or probit equation. Innovations have also been developed to calculate mean WTP without the constraint of a given distribution (Haab and McConnel, 1997; Creel and Loomis, 1997; Creel, 1995; Kristrom, 1990; Turnbull, 1976). To date, there is no single clearly superior method to compute WTP estimates. This paper compares alternative methods to calculate willingness to pay (WTP) from dichotomous choice data, with an emphasis on the advantages and disadvantages of each, as well as robustness of results for one data set.

4.2 THEORY

4.2.1 Parametric Modeling

Traditionally, dichotomous choice WTP responses (Y) are regressed against a constant, the bid amount (BID), and a vector of socioeconomic variables (X) using a logistic function:

$$Y = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 BID + X'\beta_2)]} \quad (4.1)$$

The logistic function estimates the probability that an individual is willing to pay for a good or service, given a bid amount and a set of socioeconomic characteristics. The variable Y is binomial, taking on a value of 1 for a 'yes' response, and 0 for a 'no' response. In estimating this function, the probability of a 'yes' response can be modeled for varying bid amounts (dollar values) and socioeconomic characteristics (such as income, education, age, etc.) As shown in Equation (4.2), a variation on this procedure is to use the log of the BID amount. The log transformation will force WTP to fall between zero and infinity.

$$Y = \frac{1}{1 + \exp[-(\beta_0 + \beta_1 \ln BID + X'\beta_2)]} \quad (4.2)$$

Mean and median WTPs are calculated using regression coefficients, matrix β_2 vector β_0 and vector (β_1) . The non-negative mean willingness to pay from the linear logit model in Equation (4.1) is calculated using a formula from Hannemann (1989):

$$\text{Median WTP} = \frac{(\beta_0 + X'\beta_2)}{|\beta_1|} \quad (4.3)$$

WTP from the log-logistic function shown in Equation (4.2) has corresponding expressions (Hannemann, 1984):

$$\text{Mean WTP} = -e^{-\beta_0/\beta_1} \frac{\pi/\beta_1}{\sin(-\pi/\beta_1)} \quad (4.4)$$

$$\text{Median WTP} = e^{-\beta_0/\beta_1} \quad (4.5)$$

There is an important difference between the mean and median WTP estimates. The median value is less affected by extreme outliers, but it places less importance on the votes of the outlying responses. In the case of the log-logit estimation, the mean WTP is sensitive to changes in the distribution resulting from outliers (Hannemann, 1984). If the coefficient on the bid amount is greater than -1, this functional form cannot be used because the WTP is undefined.

The probit model leads to a similar functional form as Equation (4.1), but it uses a cumulative normal distribution, shown in Equation (4.6):

$$P_i = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\beta_0 - \beta_1 \text{BID}_i + X_i \beta_2} \exp(-s^2/2) ds \quad (4.6)$$

where P_i is the probability of respondent i saying yes to a given bid amount, and s is a standard normal variable. The mean and median WTP are calculated using Equation (4.3), they are equal because of the cumulative normal distribution inherent in probit modeling. Advantages of the probit over the logit model include less need for a large sample. Studenmund (1992) suggests that logit models should have a sample size of at least 500 observations.

The model specification is more cumbersome, and probit's historic disadvantage has been the computer time required to run a model. However, with software advances, this is no longer the case.

The next estimation method is similar to Logit, but uses a slightly asymmetric distribution known as the Weibull distribution:

$$\Pr(y_i = 0) = \exp(-\exp(\beta_0 + \beta_1 Bid + X'\beta_2)) \quad (4.7)$$

Coefficients from both the logit and probit functions can be used to generate confidence intervals by a method developed by Park, Loomis and Creel (1991) from the Krinsky and Robb(1986) method. Their approach makes thousands of draws of the coefficients using the variance-covariance matrix and WTP is calculated for each draw of the coefficients. This same technique is used in the Weibull estimation method, as in Equation (4.3).

These estimators are appealing because of the explanatory power of including socioeconomic variables, while non-parametric estimates assume a homogeneous sample. If a given sample is not a perfect representation of the population, WTP estimates can be projected onto the entire population using demographic information obtained from sources like the Census Bureau. The disadvantage of parametric approaches is that the data is forced into fitting a given distribution. Non-parametric estimation techniques are distribution-free, so the researcher gets a more realistic sense of the cumulative density functions and mean WTP of the sample.

Duffield and Patterson (1991) suggest that the non-parametric models should be used in survey bid design, not necessarily as a replacement for the parameter approaches to estimating the final WTP.

4.2.2 Monte-Carlo Extensions of Parametric Modeling

From the basic Logit model, Monte-Carlo simulations can be used to approximate the distribution of the error term from the empirical distribution function of the sample so as to allow calculations of confidence intervals around mean WTP estimates. Two approaches are Bootstrapping and Jackknife. These techniques do not impose a given distribution onto the resulting estimates, however, they do take the estimates from the means of a series of logit estimates. Because the final results do not have a specified distribution, it is said that the data is allowed to pull itself up by its own bootstraps. Thus, the first method is called "Bootstrapping" (Davidson, Mackinnon, 1993). The empirical distribution function is a step function, with each step equal to $1/n$, where n is the number of observations in the randomly drawn sample. The Bootstrap method draws a large number of random samples from the residuals of the logit function (4000 in this case), and each sample is drawn with replacement. The average Bootstrapping tends to result in probability density functions with fatter tails than that of the cumulative normal distribution, and the distribution may not be asymmetric, so researchers should be especially aware of any differences that may result in the confidence intervals.

The Jackknife technique is an approximation of the bootstrapping method, in which the mean and variance of the sample distribution are estimated through random drawings of the data set (again, with replacement). Both Bootstrapping and Jackknife techniques can obtain WTP point estimates by way of restricted or unrestricted measures:

$$\text{unrestricted: } \frac{\beta_0}{|\beta_1|} \quad (4.8)$$

$$\text{restricted: } \frac{\ln(1 + e^{\beta_1})}{|\beta_1|} \quad (4.9)$$

4.2.3 Semi-nonparametric Distribution-Free Modeling

This technique, originally applied to Contingent Valuation data by Creel (1995) and simultaneously by Heng and Randall (1998) and expanded by Creel and Loomis (1997) uses the semi-nonparametric distribution-free (SNPDF) estimator to calculate mean compensating variation (ie WTP). This method does not depend on distributional or functional form as is the case in logit or probit estimation. The advantage of SNPDF estimation is that it avoids the likelihood of biased and inconsistent estimation that can result from a wrong distributional assumption, yet allows for incorporation of demographic variables in the WTP function. Unfortunately, this method is not as efficient in its estimators as the parametric methods.

To perform this estimation, the logit model is generalized as a Fourier series:

$$\Delta v_F = \sum_{a \in V} [b_a \ln a + u_a \cos s_a(\ln a) + v_a \sin s_a(\ln a)] \quad (4.10)$$

Where:

Δv_F is the estimated change in the population mean of the indirect utility resulting from providing the good in question and conditional on socioeconomic characteristics.

V is the set of socioeconomic characteristics that influence WTP

$s_a(\ln a)$ represents a scaling function, which shift and scale $(\ln a)$ to lie between 0 and 2π .

u_a is the population mean of the indirect utility function, with a representing the two different states of policy provision. In other words, u_1 is the function with the protection policy in place, u_0 is the function without the protection policy.

The logit function is easily invertible because it is continuous and strictly increasing. This inverse function uses independent variables that are the distributional function of the error terms from the original utility difference, given the bid amount. The stochastic specification is the logit distribution, but the functional form of the underlying utility difference function is unknown. Maximum Likelihood techniques are applicable, but the final estimation has an unspecified functional form (see Creel 1995 for full description of this technique).

The mean and median WTP are calculated as follows:

$$\text{Mean WTP: } E(WTP|w) = \int_0^{\infty} p(w, B)db \quad (4.11)$$

$$\text{Median WTP: } p[w, E(WTP|w)] = 0.5 \quad (4.12)$$

The basic idea is that the probability $p(x)$ defines the likelihood function for a Bernoulli trial. $p(x)$ can be written as $p(x) = L(L^{-1}(p(x)))$, where $L(*)$ is any distribution function, e.g., the logit. Then $L^{-1}(p(x))$ is a function of unknown form that may be modeled using the Fourier form. This is consistent for the unknown function, so the logit probability with this as the argument is also consistent.

4.2.4 Non-Parametric Modeling

In 1976, Turnbull pioneered a distribution-free strategy, which when applied to CVM eliminates the possibility of negative WTP estimates. Negative WTP estimates can be problematic in most parametric models. The data is separated into intervals based on the bid amounts. The probability density function for each bid amount, p_i , is defined as the percentage of respondents voting “no” to a given bid amount (c_{j-1}), this percentage must be less than or equal to the percent of “no” votes to the next higher bid amount (c_j). It is therefore the estimated probability that a respondent’s maximum WTP falls within the interval c_{j-1} to c_j (Haab and McConnell, 1997):

$$p_i = P(c_{j-1} < WTP \leq c_j) \quad (4.13)$$

The likelihood function can be written as:

$$L(p; N, K) = \sum_{j=1}^M [N_j \ln(\sum_{i=1}^j p_i) + K_j \ln(1 - \sum_{i=1}^j p_i)] \quad (4.14)$$

where N is the number of respondents who respond 'no' to c_j , and K is the number of respondents who say 'yes', M is the number of bid amount used. This function is not as difficult to calculate as it first appears and Kristrom (1990) describes it as a "computation that can be done on the back of an envelope." The method requires a monotonically decreasing probability sequence that can be calculated using a simple algorithm:

$$p_i = \frac{k_i}{n_i} \quad (4.15)$$

In this case, i denotes individual $i=1,2,\dots,N+K$. If the data set is not monotonic, then adjacent values are pooled as in Equation (4.16) until it is.

$$p_i = \frac{(k_i - k_{i-1})}{(n_i - n_{i-1})} \quad (4.16)$$

This will lead to the probability density function, and subsequently to the cumulative density function. The mean WTP is calculated by multiplying the monotonic probabilities (p_i) by the bid amounts (c_j).

This simple technique has been estimated by a number of researchers (Haab and McConnell, 1997; Duffield and Patterson, 1991; Kristrom, 1990).

Slight variations of the Turnbull estimation include the assumption of a piecewise linear functional form, with an arbitrarily chosen upper bound. Haab and McConnell point out that this can lead to different estimates of mean WTP, depending on the range of the bid amounts. They assume that the p_i 's are distributed asymptotically normal, so that more efficient confidence intervals can be constructed if the mean and variance of the sample are calculated. The variance of the lower bound estimate is given by:

$$V\left(\sum_{j=1}^{M+1} p_j c_{j-1}\right) = \sum_{j=1}^{M+1} c_{j-1}^2 (V(F_j) + V(F_{j-1})) - 2 \sum_{j=1}^M c_j c_{j-1} V(F_j) \quad (4.17)$$

Where F_j is the cdf for bid c_j . Further, $V(F_j)$ is given by:

$$V(F_j) = \left(-\frac{\partial^2 L}{\partial F_j^2}\right)^{-1} = \frac{F_j(1-F_j)}{N_j + K_j} \quad (4.18)$$

While the non-parametric is distribution free, it has at least two drawbacks when compared to parametric approaches. First, large sample sizes are needed at each bid amount to reduce the chances of non-monotonicity and resulting loss in efficiency of the estimator from pooling adjacent bid responses. Second, coefficients, such as demographics cannot be included when estimating WTP.

While each approach has conceptual advantages and disadvantages, a key question remains: does the selection of a particular estimator result in significant differences in WTP?

After all, benefit-cost analysis is a policy driven empirical undertaking. At a scientific level, we can test the hypothesis that WTP of the alternative estimators are significantly different. Specifically:

$$H_0: WTP_{Logit} = WTP_{Probit} = WTP_{Bootstrap} = WTP_{Jackknife} = WTP_{SNPDF} = WTP_{Nonparametric} \quad (4.20)$$

$$H_A: WTP_{Logit} \neq WTP_{Probit} \neq WTP_{Bootstrap} \neq WTP_{Jackknife} \neq WTP_{SNPDF} \neq WTP_{Nonparametric} \quad (4.21)$$

For actual policy and benefit -cost analysis, decision makers are perhaps more interested in whether any differences in estimators would change the economic efficiency recommendations regarding a particular policy action. Thus even if Equation (4.20) is rejected, and if the significant differences in WTP are small enough not to change the outcome of the benefit-cost analysis, then selection of the estimator is not crucial. Alternatively, if the variance of WTP is large, policy relevant differences in WTP estimates may not be statistically different, but could result in reversals of efficiency recommendations from one of benefits exceeding costs to one of costs exceeding benefits. To investigate both these possibilities, we rely on the following case study.

4.3 THE DATA

During the summer of 1996, a sample of 1600 respondents received a mail survey concerning a program to protect Critical Habitat Units (CHUs) of nine endangered fish species which live in several rivers in the southwestern United States. The respondents are asked if their household would pay a given bid amount to maintain these CHU's:

If the Four Corners Region Threatened and Endangered Fish Trust Fund was the only issue on the next ballot and it would cost your household \$___ every year, would you vote in favor of it?

YES NO

The bid amounts range from \$1 to \$350. The survey followed most recommendations made by Mitchell and Carson (1989) and the NOAA panel (D.O.C., 1993), except employing a mail survey following the Dillman (1978) Total Design Method (first mailing, post card, second mailing, phone call, third mailing). The response rate was 53.7%, which is 715 surveys (accounting for undeliverable surveys).

4.4 RESULTS

The coefficients from the models that were estimated are presented in Table 4.1.

The latent variable (yes=1 and no=0) is regressed against a *Constant* term, the *BID* amount, the respondents highest level of completed *Education* (in years), the respondent's household *Income*, and responses to a group of opinion and knowledge holding questions. *Projob* and *Protect* are the result of a series of likert scale statements which were rated from strongly agree to strongly disagree. The *Projob* statements included things such as, "Businesses should be allowed to extract natural resources from Federal Lands". The *Protect* statements included things such as, "Plants and animals have as much right as humans to exist". *Fishknow* is a variable that is equal to 1 if the respondent has read or heard about the threatened and endangered fish in the Colorado River, and 0 otherwise.

Table 4.1
Results from Model Regressions

Technique	Coefficients and (t-statistics)							Chi-squared test
	Constant	BID	Education	Income	Projob	Protect	Knowfish	
Logit	0.424 (0.57)	-0.006 (-4.91)	0.050 (1.22)	6.2e-06 (2.17)	-0.219 (-3.96)	0.510 (8.93)	0.293 (1.43)	157.82
Probit	0.183 (0.42)	-0.003 (-4.91)	0.030 (1.27)	3.6e-06 (2.17)	-0.135 (-4.24)	0.296 (9.51)	0.167 (1.38)	190.37
Log-Logit	1.473 (1.91)	-0.387 (-5.87)	0.037 (0.90)	6.5e-06 (2.26)	-0.222 (-4.00)	0.512 (8.88)	0.293 (1.42)	155.27
Weibull	-0.050 (-0.11)	-0.003 (-4.71)	0.057 (2.34)	3.8e-06 (2.15)	-0.095 (-2.77)	0.367 (9.38)	0.136 (1.08)	195.51

In all of the modeling techniques, the coefficients displayed the same signs, indicating comparable interpretation of the variables. The coefficient on *BID* is negative, indicating that the higher the bid amount, the less likely it is for a respondent to vote in favor of the program. *Education* and *Income* have positive coefficients, showing evidence that respondents with higher levels of education and income would be more likely to vote yes for the program. *Projob* and *Protect* have opposing signs, which suggest that respondents agreeing with *Projob* questions would be less likely to vote in favor of the program, and those agreeing with the *Protect* questions would be more likely to vote in favor of the program. Finally, the positive coefficient on *Fishknow* implies that respondents who have read or heard about the threatened and endangered fish in the Colorado River would be more likely to vote in favor of the program that protects them.

Also included in Table 4.1 is the chi-squared test for goodness of fit. This test looks at the overall significance of the model by comparing the calculated test statistic, Equation (4.22), to a critical chi-squared statistic.

$$c = -2(LL_R - LL_U) \quad (4.22)$$

LL_R and LL_U are the Log likelihoods for the restricted and unrestricted models respectively. The critical chi-squared statistic is 14.07 for 5% level of significance. In all cases, this test indicates significance of the models.

Because of the differences in the assumptions and modeling methods, the eight statistical techniques described above lead to the results in Table 4.2 and Table 4.3. The results are divided into two categories, Unrestricted and Restricted, where the term restricted indicates estimators that force the WTP distribution to fall exclusively in the non-negative region. This is done in order to avoid “double counting” costs. It is worth noting that the confidence intervals of all of the techniques overlap with the traditional logit approach. This indicates that none of the estimates are statistically significantly different from the logit estimates. This does not mean however, that the results will be interpreted the same by a resource manager, as the means vary relative to each other.

Table 4.2
Results from Unrestricted WTP Techniques

Technique	Mean	Median	95% Confidence Interval
Logit	\$132.83	\$132.83	\$95.82-\$196.37
Probit	\$137.58	\$137.58	\$100.72-\$199.33
Weibull	\$231.49	\$221.20	\$163.53-\$356.62
Bootstrapping, Unrestricted	\$118.50	\$114.56	\$81.61-\$177.66
Jackknife, Unrestricted	\$116.98	\$115.06	\$81.03-\$163.73
Semi-nonparametric Distribution Free	N/A	N/A	N/A
Non-parametric	\$142.73	\$40.91	\$131.86-\$153.60

Table 4.3
Results from Restricted WTP Techniques

Technique	Mean	Median	95% Confidence Interval
Log-Logit	N/A	N/A	N/A
Bootstrapping, Restricted	\$225.42	\$213.09	\$150.14-\$370.77
Jackknife, Restricted	\$219.76	\$213.21	\$154.73-\$319.60

When comparing the 95% confidence intervals for all of the estimation techniques, it becomes apparent that none of the techniques are significantly different from the logit estimations, which is considered by many to be the industry standard for dichotomous choice CVM. The confidence interval for the logit model is \$152.30-\$320.72. This can be compared to the confidence intervals for the probit (\$100.72-\$199.33), unrestricted Bootstrapping and Jackknife (\$81.61-\$177.66 and \$81.03-\$163.73 respectively), nonparametric (\$131.86-\$153.60), weibull (\$163.53-\$356.62), and restricted Bootstrapping and Jackknife models (\$150.14-\$370.77 and \$154.73-\$319.60 respectively). The log-logit and SNPFD models could not be estimated because of the nonmonotonicity. WTP is not defined in either case because of the large BID coefficient in the log-logit model and the nonmonotonicity in the SNPFD model. Also to be noted is the small overlapping range of the logit and nonparametric estimates. This is due primarily with the truncation of the nonparametric estimates. If the surveys included bid amounts larger than \$350, the confidence intervals would rise significantly with each yes response to larger bid amounts. While we fail to reject the null hypotheses of equality, the large range of mean WTP (\$113-\$225) could be enough to change a recommendation on the economic efficiency of various measures to protect critical habitat.

A more stringent test for significant differences is shown in Table 4.4. This table displays a comparison between the Mean WTP estimates and the 95% confidence intervals for all of the techniques in order to see if the Mean values of each technique falls within the confidence interval of every other technique.

If it does, this is indicated with a “YES” in the corresponding row and column:

Table 4.4
Do WTP Estimates Fall Within the Range of Other Technique’s Confidence Intervals?

		95% Confidence Intervals								
Means		Logit \$96-\$196	Probit \$101-\$199	Weibull \$164-\$357	Bootstrap. Unrestricted \$82-\$178	Jackknife. Unrestricted \$81-\$164	Non- Parametric \$132-\$154	Bootstrap. Restricted \$150-\$371	Jackknife. Restricted \$155-\$320	
		Logit \$132.83	N/A	YES	NO	YES	YES	YES	NO	NO
		Probit \$137.58	YES	N/A	NO	YES	YES	YES	NO	NO
		Weibull \$231.49	NO	NO	N/A	NO	NO	NO	YES	NO
		Bootstrap. Unrestricted \$118.50	YES	YES	NO	N/A	YES	NO	NO	NO
		Jackknife. Unrestricted \$116.98	YES	YES	NO	YES	N/A	NO	NO	NO
		Non- parametric \$142.73	YES	YES	YES	YES	YES	N/A	NO	NO
		Bootstrap. Restricted \$225.42	NO	NO	YES	NO	NO	NO	N/A	YES
		Jackknife. Restricted \$219.76	NO	NO	YES	NO	NO	NO	YES	N/A

Table 4.4 suggests that the null Hypothesis of equality should be rejected.

4.5 CONCLUSIONS

The contingent valuation method is the only available method to estimate passive use values. This method is controversial for many reasons, including the techniques used to estimate willingness to pay. This paper shows evidence that confidence intervals do not indicate significant differences between various modeling techniques from the standard logit technique when comparing the confidence intervals. This, however, is not an exacting comparison. When a more rigorous comparison is compiled, such as mean WTP estimates and their proximity to the confidence intervals of other techniques, the differences between techniques are more pronounced. Out of the 56 possible combinations, only 24 mean WTP estimates fell within the 95% confidence intervals of the other techniques. This is compared to 32 mean WTP estimates that fall outside of the confidence intervals of other techniques.

The distributional assumptions may contribute to the significant differences between the various estimation techniques. The main distributional assumption is the restriction of the Wtp to fall only in the nonnegative region. Some parametric methods outlined in this study allow for negative bid amounts, which may lead to the double counting of costs when used in a cost-benefit analysis. The log-logit approach forces the model to lie in the positive region, but is sensitive to outlying observations. The WTP and the confidence intervals could not be estimated using the log-logit method in this study because the coefficient on the bid amount was greater than -1, indicating an undefined WTP amount.

The WTP and confidence intervals could not be estimated for the Semi-nonparametric Distribution Free technique either, because of non-monotonicity. The weibull, restricted Jackknife and Bootstrapping techniques do not allow for negative WTP values. Because the data is forced into the positive region, estimates will be relatively larger than that of the unrestricted techniques.

Nonparametric estimation techniques have advantages in the fact that they do not impose a distribution onto the data, but they can lead to inconsistent results depending on the maximum bid amount, and the size of the sample. These techniques do not allow for the inclusion of socioeconomic characteristics, so many factors that respondents may consider are ignored.

Resource managers need to use caution when interpreting WTP estimates. They should be made aware of the estimation technique, and the assumptions associated with it. Mean and Median WTP can differ relative to one another, so both should be reported. All techniques have advantages and disadvantages, so the authors suggest that sensitivity analysis should be performed if the benefit-cost ratio is close to one to ensure economic efficiency recommendations are robust in the statistical estimator used.

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APPENDIX IA

GAUSS CODE FOR CONTINGENT VALUATION DATA

----- CVM.PRG follows -----

@ program to do Cooper's CVM stuff. @

@BOXCOX PRG

CVMBOOT PRG

CVMJACK PRG

CVMLOGIT PRG

CVMWEIB PRG

DBCVM PRG

DWEABS PRG

DWEABS2 PRG

NONPARA2 PRG

@use grblutl1 ;

library grbllib.grblmlec ;

clear dataset,dat_type.usenam_g,defltdir.fl.title ;

closeall;

@ globals used for GRBLMLEC @

vctype=1 : @ 1=Use Hessian. 2=Use BHHH, 3=Use 'white' @

```

steptype=1;          @ 0)Steplength=0. 1)GOLDEN @
ditype=1 ;          @ 1=Hess. 2=BHHH -- ONLY IF WEIGHTED@
_mlsteep=0 ;        @ 0=no steepest, 1=Steepest, all coeffs
                    2=Steepest, all, then 1-at-a-time @
                    @_mlsteep is declared in GRBLMLEC.ARC @
_mlratmax=2 ;      @ satisfy 2 (of possible 3) stopping criteria @
_mllepsb=1e-4;
_mllepsg=1e-4;
clear _titles,_title01 ;  @_title01 used for batch mode @
_titles=make_mtx("_TITLE".10);
outname="CVM.OUT" ;
output file=^outname ; output off ;
CLS ;
CALL BOLDON ; CALL YELLOWON ;"

```

```

CCCCCCCCCCCCCCCC VV      VV      MMMMM  MMMMM
CCC                VV      VV      MM   MM  MM   MM
CCC                VV      VV      MM   MM MM   MM
CCC                VV      VV      MM   MMM   MM
CCC                VV  VV      MM                MM
CCC                VV VV      MM                MM
CCCCCCCCCCCCCCCC  VVV      MM                MM

```

```

";CALL NORMALON :";

```

A Program to Assist in the Design, Estimation, and Interpretation
of a Contingent Valuation Model (CVM).

```

@c 1994. Joe Cooper and Daniel Hellerstein, USDA/ERS. Washington DC 20005.";

call keypause(15,-1);

clear usenam_g;

clear dataset,dat_type,defltdir ;

clear njvars,njnotes ;

let njvars=BOXCOX BOOT JACK LOGIT WEIBIT DBLOGIT DWEABS DWEABS2

NONPARA OUTPUT TITLE EXIT HELP ;

njnotes=make_mtx("njnote",rows(njvars)) ;

njnote01=" Use BOX COX to deduce distribution of data ";

njnote02=" Logit, using BOOTSTRAP methods to compute C.I.";

njnote03=" Logit, using JACKKNIFE methods to compute C.I.";

njnote04=" Logit, using Krinsky & Robb methods to compute C.I." ;

njnote05=" Weibit, using K & R ... ";

njnote06=" Double Bounded Logit " ;

njnote07=" Find optimal # of bid values (symmetric distribution)";

njnote08=" Find optimal # of bid values (Asymmetric distribution)";

njnote09=" Non-parametric estimation of WTP using survival function.";

njnote10=" Select output file ";

njnote11=" Write TITLE to output file ";

njnote12=" Exit Program " ;

njnote13=" Description of options " ;

len_nj=zeros(rows(njvars),1);

```

```

ii=1;

do while ii le rows(njvars) ;

    tmp=get_mtx(njnotes,ii);

    len_nj[ii]=strlen(tmp);

    ii=ii+1;

endo;

foobar ;

closeall ;

    tmp=grblopt3(" Select a CVM option to execute .... ",
                njvars,njnotes,"CVM","",
                "CVM",miss(1,1),miss(1,1),-4);

tmp=missrv(tmp,12);

if njvars[tmp]$=="BOXCOX" ;

    call boxcox ;

elseif njvars[tmp]$=="NONPARA" ;

    call nonpara ;

elseif njvars[tmp]$=="LOGIT" ;

    call cvmlogit ;

elseif njvars[tmp]$=="DBLOGIT" ;

    call dlogit ;

```

```

elseif njvars[tmp]$=="JACK" ;
    call cvmbjack(1) ;
elseif njvars[tmp]$=="BOOT" ;
    call cvmbjack(0) ;
elseif njvars[tmp]$=="DWEABS" ;
    call dweabs ;
elseif njvars[tmp]$=="DWEABS2" ;
    call dweabs2 ;
elseif njvars[tmp]$=="WEIBIT" ;
    call dweib ;
elseif njvars[tmp]$=="HELP" ;
    call cvmhelp(njvars[1:10],njnotes[1:10]) ;
elseif njvars[tmp]$=="EXIT" ;
    stop ;
elseif njvars[tmp]$=="OUTPUT" ;
    if files(outname,0)$/=0 ;
        oy=getyesno(" View current output file (NO=Open new one) ",1);
    else ;
        oy=0;
    endif;
    if oy==1 :
        call pickf_pv(outname."Viewing current output file: ");

```

```

else ;

" Output file name (ENTER=CVM.OUT) ?";; outname=cons;?;

if outname$=="";

    Outname="CVM.OUT" ;

    OUTPUT FILE=^outname ;

    output on ; ?; output off ;

else ;

    output file=^outname ; output off; @Default output file @

    output on ; ?; output off ;

endif;

endif;

status=0;

elseif njvars[tmp]$=="TITLE" :

    call maketitl(_titles);

    call wrtetitl(_titles);

endif ;

goto foobar ;

$tmp;

end;

@-----@

proc cvmhelp(njvars.njnotes) ;

local tmp ;

```

call normalon;

"5/93. Joseph Cooper and Daniel Hellerstein.

USDA/ERS/Resources and Technology Division

1301 New York Ave. NW, rm. 508

Washington DC, 20005-4788

(202) 219-0403";

cls;

call normalon ; call boldon ; call cyanon ;

"General Description of CVM Programs ";

call normalon ;

"CVM is a collection of dichotomous choice and double bounded CVM related programs designed to be run with the Gauss 3.1 run-time module. To allow the programs to be readily accessible to the typical researcher, they are designed to operate on both GAUSS data sets, and on ASCII input data sets (e.g.; the *.prm files created in Lotus 123).

For details on individual options. select the option and then hit F1";

call keypause(40,-1);

 SCROLL 9|1|40|80|0|0 ;

 loads tmp=CVMHELP ;

 call disptext(9.22.tmp,&boldon.&yellowon);

retp(0);

endp;

@-----@

@ similar to opt3, but 2 sets of options displayed @

```
proc grblopt3(prompt,keyword,keynote,basename,prompt1,prompt2,keyword2,keynote2,idef);  
  
    local foo,tmp,ar,ndo,ii,inow.waspage,inowold,stgname,isit,amess1 ;  
  
    local topline,pages,perpage,instline,aword,ith1,ith2,onpage ;  
  
    local ntmp,ntmplins,tmp2,holdit,thisword,ict,ndo0 ;  
  
    local grblpath,messnew ;  
  
    if idef<rows(keyword) and idef>0;  
        amess1=" Currently Selected: " $+ keyword[idef] ;  
    else ;  
        amess1=""; idef=abs(idef);  
    endif;  
  
    grblpath=envget("GRBLPATH");  
  
    if grblpath$/" ;  
        if strindx(grblpath,"\".strlen(grblpath))==0;  
            grblpath=grblpath$+"\" ;  
        endif;  
    endif ;  
  
    ndo0=rows(keyword);  
  
    if scalmiss(keyword2):  
        ndo=ndo0;
```

```

else ;
    keyw=keyw|" "|keyw2 ;
    ndo=rows(keyw);
endif;
if not(scalmiss(keynote2));
    keynote=keynote|" "|keynote2 ;
endif;
prompt=pad_word(prompt,minc(strlen(prompt)|74));
gosub writtop;
@ Compute how many lines will be needed @
    topline=csrlin ;
    perpage=(23-4) - topline ;
    if perpage > ndo; perpage=ndo ; endif ;
@ If many parameters, more than 1 page needed @
    pages=trunc( (ndo/perpage)+0.9999) ;
    instline=topline+17 ;
    inow=idef; if inow>rows(keyw) or inow < 1 ; inow=1 ; endif;
    inowold=0 ;
    onpage=0;
hopit: ;
    waspage=onpage ;
    onpage=trunc( (inow/perpage)+0.99999);

```

```

ith1=((onpage-1)*perpage)+1;
ith2=minc((ith1+perpage-1)|ndo) ;
@ if new page, redraw @
if waspage ne onpage ;
    scroll topline|1|(instline-1)|80|0|0 ;
    locate instline,20 ;
    call blueon ; call blockon ;
    if pages==1 ;
        " ----- ";
    elseif pages>1 ;
        if onpage==1 ;
            " ----- PGDN for more OPTIONS -----";
        elseif onpage==pages ;
            " ----- PGUP for more OPTIONS -----";
        else ;
            " --- PGUP or PGDN for more OPTIONS -----";
        endif ;
    endif;
    call normalon ;
    FOO=ITH1; ii=0;
    do until FOO>ith2 ;
        format 1.8;

```

```

ii=ii+1;

locate topline+ii-1,3 :

if foo==ndo0+1;          @ prompt2 is special line @

    call normalon ;call blockon ; call yellowon ;

    $prompt2 :

    call normalon;

    foo=foo+1 ;

    continue :

endif;

if foo==inow ;

    call boldon ; call cyanon ;

endif ;

$keyw[foo];;

if foo==inow ; call normalon ; call boldon ; endif ;

locate topline+ii-1,13 ; " : " ;;

if foo le rows(keynote) and not(scalmiss(keynote));

    tmp=get_mtx(keynote[..1],foo);

    $pad_word(tmp,62) ;

else ; ;

endif ;

call normalon :

FOO=FOO+1;

```

```

endo;

else ;          @ same page @

if inowold ge ith1 and inowold le ith2

    and inowold ne ndo0+1 ; @ normal for old choice @

    foo=inowold-ith1 ;

    locate topline+foo,3 ;

    $keyw[inowold];;

    locate topline+foo,13 ; " : " ;;

if foo le rows(keynote) and not(scalmiss(keynote));

    tmp=get_mtx(keynote[.1],inowold);

    $pad_word(tmp,62) ;

endif;

endif; @old choice on current page @

if inow ne ndo0+1;

    foo=inow-ith1 ;          @ hilite current choice @

    locate topline+foo,3 ;

    call boldon ; call cyanon ;

    $keyw[inow];;

    call normalon ; call boldon ;

    locate topline+foo,13 ; " : " ;;

if foo le rows(keynote) and not(scalmiss(keynote));

    tmp=get_mtx(keynote[.1],inow):

```

```

        $pad_word(tmp.62) ;

    endif;

    call normalon ;

endif;

endif ;

@ USER INPUT >..... @

    locate instline+1,1 ;

    " Select an option (ESC=Exit, F1=Help): ";;

    aword=upper(cons2) ;

@ Done ? @

    if scalmiss(aword); ?;retp(miss(1,1)) ; endif ;

@ Subject chosen , return element in array@

    if aword$==" " and inow ne ndo0+1; format 1.8 ;

        ?; if inow>ndo0; inow=inow-1 ; endif;

        retp(inow);

endif;

@ Subject chosen ..., so display help if available @

    if type(aword)== 6;

        if aword==1059 ;

            onpage=0 ;

            thisword=keyw[inow];

            locate instline+2.1 ;

```

```

stgname= "" $+
    pad_word(basename, minc(3|strlen(basename))) $+
    pad_word(thisword, minc(5|strlen(thisword))) $+ ".FST";

@ does the .FST file exist ? @

isit=1;

if (files(stgname,0)$==0) ;
    if grblpath$==" " ;
        stgname="\GAUSS\GRBL\HELP\" $+ stgname :
    else ;
        stgname=grblpath $+ "HELP\" $+ stgname :
    endif;
    if (files(stgname,0)$==0) ;
        isit=0;
    endif;
endif;

@ get it, or display NA message @

if isit==0 ;
    scroll topline|1|(instline+3)|80|0|0 :
    locate topline+5.10 ;
    call boldon ; call blueon : call blinkon ; format 1.8 ;
    " No HELP available for: ";;
    call normalon ; call boldon; $thisword :

```

```

    $stgname;

    locate instline.22:

    call keypause(30,-1);

    gosub writtop;

else ;

    ict=0;

    loads tmp=^stgname ;

    SCROLL TOPLINE|1|40|80|0|0 :

    gosub writtop2;

    call disptext(topline.20,tmp,&boldon.&yellowon);

    gosub writtop;

    SCROLL TOPLINE|1|40|80|0|0 :

    endif ;

endif ;

endif ;

inowold=inow ;

@ is it non-ascii I/o ?????????????? @

if type(aword)==6 :      @ cursor key @

    if aword==1072 :      @ up @

        inow=inow-1 ;

        if inow < 1 ; inow=ndo ; endif ;

    elseif aword==1080 or aword==13 :      @ down @

```

```

inow=inow+1 ;

if inow > ndo : inow=1 ; endif ;

elseif aword==1071 :    @ home @

    inow=1 ;

elseif aword==1079 :    @ end @

    inow=ndo;

elseif aword eq 1081 ;    @pgdn @

    inow=minc((inow+perpage)|ndo) :

elseif aword eq 1073 ;    @ pgup @

    inow=maxc((inow-perpage)|1) ;

elseif aword eq 1045 ;    @ alt-x = done @

    if inow>ndo0; inow=inow-1 ; endif;

    cls ; ?:retp(inow) ;

elseif aword eq 1061 ;    @ f3 = done @

    cls ; ?:retp(miss(1,1)) ;

elseif aword==13 :    @ enter @

    inow=inow+1 ;

elseif aword==1044 :    @ alt-z for temp exit to dos @

    ?;

    call normalon; call blockon ;

    " Enter EXIT to return to this program." ;

    call normalon ;

```

```

dos:

onpage=0 ;

gosub writtop;

elseif aword==1059 ;    @F1 = help (also ALT-H or ? ) @

locate instline+2,1 ;

call yellowon ;

" Select an OPTION using cursor keys or by entering option name, then hit ENTER.

Note: F1 for help on highlighted option, ALT-Z for temporary exit to DOS.":

call normalon ;

endif ;

@ IF here, normal ascii input, search for option match @

ELSEIF NOT(SCALMISS(INDCV2(AWORD,keyword)));

inow=INDCV2(AWORD,keyword);

endif;

goto hopit ;

@ write prompt and header line @

writtop::

cls ;

call normalon ; call boldon ;

foo=(80-strlen(prompt))/2 ;

locate 1,foo ;

$prompt ;

```

```

call blockon ; call cyanon:

" OPTION " :: call normalon ; call blockon :

": Short Description ";;

call normalon ;

if amess1$/" ;

    call cyanon; call boldon ; $amess1 ;

    call normalon ;

else ;

    ?;

endif;

if prompt1$/" ;

    " ";;

    call blockon ; call yellowon ;

    $prompt1 ;

    call normalon ;

endif;

return;

writtop2::

cls ;

    call normalon ; call boldon ;

    foo=(80-strlen(prompt))/2 :

    locate 1,foo ; format 1.8 :

```

```

    $prompt ;
    call blockon: " OPTION      :" $thisword;
    call normalon ;

return;

endp;  @ retp @

/*****/

proc boxcox ;

local fl,dta,n,rowno,colno,x,i,xls;

local incre,maxit,g,grev,count,l,iter,xg,y,dif,avg,lnx,sum,chitest,restl;

local indx,indxvar,varlist,oink ;

cls ;

call boldon ;

"

                BOX COX

";

call normalon ;

"

```

This program uses the box-cox procedure to help deduce the distribution of the data. If Lamda = 0, the data is lognormally distributed, and if Lamda = 1, the data has a normal distribution.

Enter the file (ASCII or GAUSS) containing the open ended pre-test data (you will also be asked to provide a 'variable name' "):

```

?:

    {dataset.dat_type.usenam_g,defltdir}=grbldata(dataset.dat_type,defltdir);

open fl ^=^usenam_g ;

IF F1<0;

    RETP(0) ;

ENDIF;

varlist=getname(usenam_g);

{indx,indxvar}=get2var(

" Select variable to examine ",

varlist[1],varlist.

" The variable you selected will be examined using a BOX COX procedure ",

0);

cls ;

format /ld 1,8 ;

" Using BOX COX to examine distribution of ...":

" variable: " $indxvar ;

" in file: " $usenam_g ;

?:

" ( hit the ESC key to cancel) ":

dta=readr(fl,rowsf(fl));

?:?:?:?:?:

rowno = csrlin-2;

```

```

colno = csrcol;

x = dta[..indx];

i = 1;

x=packr(x);

x1s=mk_index(x .le 0) ;

if not(issmiss(x1s)) ;

    x[x1s]=ones(rows(x1s),1)*0.000001 ; @ use arbitrarily small value @

endif;

n=rows(x);

incre = .01; @increments for MLE scan@

maxit = 2/incre; @scan range for gamma should be from -1 to 1@

g = seqa(0.incre.maxit/2+1); @create range of values from -a to a@

grev = -rev(g); grev = grev[1:maxit/2,1];

g = grev|g;

count = rows(g);

l = zeros(maxit+1,1);

iter = 1; /*g[1,1] = -1.5: @value for base g (=Lambda) is arbitrary@ */

do while iter <= maxit+1;

    oink=key;

    if oink==27 ; " cancelled at users request .... " ; call keypause(3,0);

        retp(0);

endif;

```

```

if g[iter,1] /= 0;

  xg = ((x.^g[iter,1])-1)./g[iter,1];

  avg = (1/n)*sumc(xg);

  dif = (xg-avg)^2;

  lnx = ln(x);

  sum = sumc(dif);

else /*if g[iter,1] = 0 */:

  lnx = ln(x);

  avg = (1/n)*sumc(lnx);

  dif = (lnx-avg)^2;

  sum = sumc(dif);

endif;

l[iter,1] = -(n/2)*ln((1/n)*sum)+(g[iter,1]-1)*sumc(lnx);

locate rowno,colno; @fix cursor position@

print " (Boxcox) Iteration=" iter;

print " Log likelihood=" l[iter,1];

print " Corresp. gamma=" g[iter,1];;

iter = iter + 1;

endo;

cls;

y = maxindc(l): @index of MLE maximizing point@

"          ";

```

```

"          ";

print "Estimated lambda =" g[y,1];

"";

print "Unrestricted Optimal log likelihood=" l[y,1];

restl = l[maxit/2+1,1];    @restricted log likelihood - where g=0@

print "Restricted log likelihood (lambda = 0) =" restl;

chitest = 2*(l[y,1] - restl); @test if lambda different from 0 @

print " Chi-squared test with 1 degree of freedom = " chitest;

"";

if chitest < 3.841;

    "Do not reject null hypo that lambda = 0 (i.e. lognormality) at 95% sig";

else;

    "Do reject null hypo that lamdba = 0 (i.e. lognormality) at 95% sig";

    else; endif;

if chitest < 2.706;

    "Do not reject null hypo that lambda = 0 (i.e. lognormality) at 90% sig";

else;

    "Do reject null hypo that lambda = 0 (i.e. lognormality) at 90% sig";

endif;

call keypause(200,-1);

retp(0);

endp;

```

```

/*****/

@ get data from dataset @

proc (8)=goodata(usenam_g,dataset,dodb);

local fl,varlist,yvar,yindex,pvar,pindex,xvars,xindex,nxvars ;

local ctmp2,dta ;

local bidindx,bidindxl,bidindxu ;

local bidname,bidnamel,bidnameu,amess ;

closeall ;

open fl=^usenam_g ;

IF F1<0;

    RETP(0,0,0,0,0,0,0,0) ;

ENDIF;

varlist=getname(usenam_g);

geek: ;

cls;

" Using dataset: " $dataset; ? ;

if dodb==0:

    amess= " The dependent variable must be a zero/one variable ";

else ;

    amess= " Valid dependent variable values: YY=1, YN=2, NY=3, NN=4 ";

endif;

{yindex,yvar}=get2var(

```

```

" Select dependent variable (ESC=Exit)",
varlist[1],varlist,ames,0);

if scalmiss(yindex); retp(0,0,0,0,0,0,0,0); endif ;

if dodb==0;

{pindex,pvar}=get2var(

" Select price variable ",
varlist[3],varlist,

" Select the bid (price) variable.".

0);

if scalmiss(pindex);

RETP(0,0,0,0,0,0,0,0) ;

endif ;

else;

" Select the BID variables for the double bound bid model.";

{bidindx,bidname}=get2var(

" .. select 1st BID variable ","BID".getname(usenam_g),

" Select First BID variable ",0|0);

{bidindxL,bidnameL}=

get2var(

" .. select Lower BID variable ".

"BIDL".getname(usenam_g),

" Select the Lower BID variable ",0|0);

```

```

{bidindxU.bidnameU}=
    get2var(" ... select Upper BID variable ".
        "BIDU",getname(usenam_g),
        " Select the Upper BID variable".0|0);
pindex=bidindx|bidindx1|bidindxu ;
if ismiss(pindex) :
    RETP(0,0,0,0,0,0,0,0) ;
endif;

pvar=bidname|bidname1|bidnameu :

endif ;

cls;

xindex=miss(1,1); nxvars=0 ;

": Enter 'Independent (X) variables: ";

call normalon ;

ctmp2=varlist;

ctmp2[yindex]=miss(1,1);

ctmp2[pindex]=miss(zeros(rows(pindex),1),0);

ctmp2=packr(ctmp2);

xvars=listvar2(ctmp2.ctmp2) ; ?;?;?;?;?;?;

@ constant included below @

if xvars/=0:

    nxvars=rows(xvars);

```

```

        xindex=indcv(xvars.varlist);

ELSE ;

        nxvars=0;

endif;

dta=readr(f1,rowsf(f1)) ;

retp(yvar,yindex,pvar,pindex,xvars,xindex,nxvars,dta);

endp;

/*****/

PROC NONPARA ;

local

        n, k, indata, dta, bids, unib, unibno, ni, v, ni1, i, ki, tempni,
        tempni2, bot, top, x, varno, p, bid, b1, phat, y, temp2, theta, thetai,
        bf, e, s2, cov, se, tstat, avgy, tss, r2, regout, xbar, r, cof, highbid,
        lowbid, increm, incremno, bidseqa, grandm, pest, fl, sumt, pointest,
        iter, csvec, g, var, pp, bmat, all, alfa, alfa1 ;

local yindex,yvar,pindex,pvar,xindex,nxvars.ctmp2,xvars.varlist ;

local foo,mask,fmt :          @for output of results @

let mask[1,4]= 0 1 1 1 ;

let fmt[4,3]=

"-.*.s " 8 8   ".*|g" 16 8 ".*|g" 12 4 ".*|g" 12 4 ;

cls ;

call boldon ;

```

" CONFIDENCE INTERVAL ESTIMATION
 USING KRINSKY AND ROBB
 ON NONPARAMETRIC BASED WTP VALUES";

call normalon ;

"

This program produces coefficient estimates using the GLS procedure found in Judge et. al. (pg. 758, 2nd edition). Based on the coefficient estimates, the CS estimate is calculated under the survival function. The procedure is similar to Kristom's (LAND ECONOMICS, 1990) and should return similar results.

Warning: REPEAT OBSERVATIONS FOR EACH BID VARIABLE ARE REQUIRED

Enter the file (ASCII or GAUSS) containing the data.

(You will also be asked to provide the names of the dependent, price, and other independent variables). ";

?;

{dataset.dat_type,usenam_g,defltdir}=grbldata(dataset.dat_type,defltdir);

{yvar.yindex,pvar,pindex,xvars.xindex,nxvars,dta} =

goodata(usenam_g,dataset,0);

if missrv(yindex.0)==0; retp(0); endif;

```

dta=dta~ones(rows(dta),1); @ append constant @
cls;
/*do some error checking in the data set */
if maxc(dta[..yindex]) > 1 or minc(dta[..yindex]) < 0;
"Warning: either your first variable is not a 'zero/one' variable or you
have not correctly specified the dimensions of the input data set.
Try again.";
call keypause(15,-1);
goto endprog;
endif;
/* procedure to take DC CVM data set and collapse YES/NO responses into
probabilities */
n = rows(dta); k = cols(dta);
dta = sortc(dta,yindex); @sort dta on the bid variable@
bids = dta[..pindex];
unib = uniqueGR(bids,1); @vector of unique bids@
unibno = rows(unib); @number of unique bids@
ni = zeros(unibno-1,2); @sample size for each bid except first one
- column 1 is dropped later@
v = unib[1];
ni1 = counts(bids,v); @number of bid 1's@
i = 1;

```

```

do while i <= unibno-1;

    v = unib[i:i+1];

    ni[i,.] = counts(bids.v)';

    i = i + 1;

endo;

ni = ni \ ni[:,2]; @sample size for each unique bid@

/*find number of yes's for each bid*/

ki = zeros(unibno,1); @find number of yes's to each bid@

ki[1,.] = sumc(dta[1:ni[1],yindex]); @mean of each regressor for bid1@

ki[2,.] = sumc(dta[ni[1]+1:ni[1]+ni[2],yindex]);

                    @mean of each regressor for bid2@

i = 2;

do while i <= unibno-1;    @sums of yes's for bids 3 ..m @

    tempni = ni[1:i];    tempni2 = ni[1:i+1];

    bot = sumc(tempni);

    top = bot + ni[i+1];

    ki[i+1,1] = sumc(dta[bot+1:top,yindex]);

    i = i + 1;

endo;

if nxvars > 0; @i.e.have explanatory variables@

/*next get mean of independent variables for each bid*/

x = zeros(unibno,nxvars); @exlcude Y. CNST. BID, exclude obs one for now@

```

```

varno = 1;

x[1,..] = meanc(dta[1:ni[1],xindex]): @mean of each regressor for bid 1@
x[2,..] = meanc(dta[ni[1]+1:ni[1]+ni[2],xindex]);

                @mean of each regressor for bid 2@

i = 2;

do while i <= unibno-1;    @means bids 3 ..m @

    tempni = ni[1:i];    tempni2 = ni[1:i+1];

    bot = sumc(tempni);

    top = bot + ni[i+1];

    x[i+1,..] = meanc(dta[bot+1:top,xindex]);

                @mean of each regressor for bid i@

    i = i + 1;

enddo;

dta = ones(unibno,1)~unib~x~ni~ki; @OUTPUT DATA with multiple variables@
else ;    @ no independent variables (just constant)@

    dta = ones(unibno,1)~unib~ni~ki; @OUTPUT DATA without multiple variables@

endif;

@-----beginning of estimation section-----@

@ data is 'cnst, bid, others, ni, ki' where ni is number of each bid and ki is
    number of 'yes' responses to each bid@

n = rows(dta); k = cols(dta);

@dta is 'cnst, bid, others, ni, ki' where ni is number of each bid and ki is

```

```

    number of 'yes' responses to each bid@
ni = dta[..k-1];
ki = dta[.,k];
p = ki./ni;
x = dta[:,1:k-2];
bid = x[:,2];
k = cols(x); @k is revised to be number of regressors@
    @ x[:,2] = ln(x[:,2]);@ @log of bid@
i = 1; @makes sure that p[i+1] < p[i]@
do while i <= (n-1);
    if p[i] < p[i+1];
        p[i] = (ki[i]+ki[i+1])/(ni[i]+ni[i+1]);
        p[i+1] = (ki[i]+ki[i+1])/(ni[i]+ni[i+1]);
    endif;
    i = i + 1;
endo;
    @see Judge, page 758 for this model@
b1 = invpd(x'x)*x'*p; @first step@
phat = x*b1; @predicted p's, phat = P + e@
y = p; @see Judge, page 758 for this model@
temp2 = abs((phat.*(1-phat)))./ni; @add abs() in case phat > 1 or <-1@
v = zeros(n,n);

```

```

theta = diagrv(v,temp2);

thetai = invpd(theta);

bf = invpd(x'*thetai*x)*x'*thetai*y; @standard GLS estimator@

e = y - x*bf;

s2 = e'e/(n-k); @change k-2 depending on input data set@

cov = invpd(x'*thetai*x);

se = sqrt(diag(cov));

tstat = bf./se;

avgy = meanc(y);

tss = sumc( (y-avgy)^2 );

r2 = 1 - e'e/tss;

format /rd 8,5; @print results to output file@

outwidth 132;

output on ;

call boldon ;

" ===== ";

"          NONPARAMETRIC OUTPUT RESULTS ";

call normalon ;

?;?;

@print "Convergence achieved after " iter-1 " Iterations ";

print "Log likelihood = " l: @

print "Sample size (Collapsed data set) = " n: print "";

```

```

regout = zeros(k,4);

@regout[.,1] = seqa(1,1,k); @

regout[1,1]="CONSTANT" ; regout[2,1]=pvar ;

if nxvars>0 ; regout[3:2+nxvars,1]=xvars ; endif;

regout[.,2] = bf;

regout[.,3] = se; regout[.,4] = tstat;

?;

print " VARIABLE      COEF.      STD ERROR      T-STAT.";

"-----";

foo=printfm(regout,mask,fmt);

?;?;

print " R squared = " r2;

?;?;

output off;

xbar = meanc(x);

k = cols(x);

r=zeros(2,k): @collapse coefficients to grandmean and slope@

r[1,1]=r[1,1]+1;

r[1,2]=0;

r[1,1]=r[1,1].*xbar';

r[2,2]=1;

cof=r*bf: @2 X 1 vector with grand constant (1.1) and slope (2.1)@

```

```

/*find are under survival function*/

highbid = abs((0 - cof[1])/cof[2]); @find endpoint based on data@

@prob( yes to highbid) = approx. 0 - assumes linear model. v = alpha + b@

lowbid = (1 - cof[1])/cof[2]; @not in use right now@

increm = 10; @size of increment@

If (highbid >= 1000) and (highbid <= 10000);

    increm = 100;

elseif highbid > 10000 and highbid <= 20000;

    increm = 200;

elseif highbid > 20000;

    increm = 1000;

elseif increm > highbid/10; @don't want increm < highbid or too close to

    high bid - note that this is condition for highbid < 100@

    increm = highbid/100; @if highbid <= 1000, increm <= 10@

endif;

incremno = round(highbid/increm); @number of increments@

do while incremno > 130000;@a value greater than this will exceed mememory@

    increm = increm+100; @so increase increm until incremno <= 130000@

    incremno = round(highbid/increm);

endo;

bidseqa = seqa(0,increm,incremno); @create bid vector from 0 to high bid@

grandm = zeros(incremno,1) + cof[1];

```

```

pest = grandm + bidseqa*cof[2]; @predicted prob. for data fill@
@find area under the curve@
fl = .5*(pest[1,1] + pest[incremno,1]); @find area under curve@
sumt = sumc(pest) - pest[1,1] - pest[incremno,1];
pointest = increm*(fl+sumt);

print "Point estimate of WTP (calculated under the survival function
between $Bid = 0 and the $Bid that drives the probability of a 'YES'
response to zero) = " pointest;

@----- SURPLUS ESTIMATION AND KRINSKY AND ROBB C.I.---@
"

For K.R. Confidence Interval:

Please select the desired number of random draws from the
coefficient vector (we recommend at least 1000).":

iter=getaval(
" .... Enter # of draws ",1000,|6);

csvec = zeros(iter,1);

g = 1;

/* calculating the varcov for the collapsed coefficient set
using the formula for a linear function of mvn random vector */
var=r*cov*r'; @ 2 x 2 cov matrix for grand c. and slope@
pp=chol(var); @Cholesky decomposition; var = (pp)'pp@

/* make draws from mvn */

```

```

bmat = rndn(iter,2)*pp + cof: @bmat is matrix of new coeff@
/* find consumer surplus for each coefficient vector draw*/
do while g <= iter; @find CS corresponding to each vector set@
    highbid = abs((0 - bmat[g,1])/bmat[g,2]); @find endpoint based on data@
    @prob( yes to highbid) = approx. 0 - assumes linear model, v = alpha + b@
    lowbid = (1 - bmat[g,1])/bmat[g,2]; @not in use right now@
    increm = 10;
    If (highbid >= 1000) and (highbid <= 10000);
        increm = 100;
    elseif highbid > 10000 and highbid <= 20000;
        increm = 200;
    elseif highbid > 20000;
        increm = 1000;
    elseif increm > highbid/10:
        increm = highbid/100; @if highbid <= 1000, increm <= 10@
    endif;
    incremno = round(highbid/increm);
    do while incremno > 130000;@a value greater than this will exceed mememory@
        increm = increm+100; @so increase increm until incremno <= 130000@
        incremno = round(highbid/increm);
    endo;
    bidseqa = seqa(0.increm.incremno); @create bid vector from 0 to high bid@

```

```

grandm = zeros(incremno,1) + bmat[g,1];
pest = grandm + bidseqa*bmat[g,2]; @predicted prob. for data fill@
@find area under the curve@
fl = .5*(pest[1,1] + pest[incremno,1]); @find area under curve@
sumt = sumc(pest) - pest[1,1] - pest[incremno,1];
csvec[g] = increm*(fl+sumt);
g = g + 1;
endo;
all = sortc(csvec,1);
format /rd 8,5; @print results @
outwidth 132;
output on;
"          *****";
"KRINSKY AND ROBB CONFIDENCE INTERVAL RESULTS FOR THE
NONPARAMETRIC ESTIMATOR";
"";
alfa = ceil(iter*.005); @print 99%, 95%, and 90% confidence
intervals@
alfa1 = ceil(iter*(1-.005));
print "99% C.I. = " all[alfa,1] " to " all[alfa1,1];
print "";
alfa = ceil(iter*.025);

```

```

    alfa1 = ceil(iter*(1-.025));

    print "95% C.I. = " all[alfa,1] " to " all[alfa1,1];

    print "";

    alfa = ceil(iter*.05);

    alfa1 = ceil(iter*(1-.05));

    print "90% C.I. = " all[alfa,1] " to " all[alfa1,1];

    print "";

    print "Average of the Krinsky and Robb CS values = "
    (sumc(all))/iter;

    print "Median of the Krinsky and Robb CS values = "
    all[ceil(iter/2),1];

    print "POINT ESTIMATE OF WTP = " pointest;"
    *****";

    output off;

    call keypause(60,-1);

    Endprog;

    retp(0);

    endp;

    /*****/

    proc cvmlogit ;

    local varlist.yvar.pindex.pvar.ctmp2.nxvars.xvars.dta.n.k.i.xbar.b0.p0,

        pd0.iter.bd :

```

```
local info.infinv.partial.tmp.bf.temp.p.pd.l.cd.xb.cov.se.tstat ;
```

```
local ican;
```

```
local numyes,regout.lres.cvtype.reps.csvec.g,r,cof,var,pp,all,alfa,alfa1 ;
```

```
local info2,newcov.covb.t,meany0.lowerb.upperb;
```

APPENDIX IB

GAUSS CODE FOR CONFIDENCE INTERVALS AROUND UNRESTRICTED MEAN WILLINGNESS TO PAY

CISSETUP.PRG

```
CLS;

format 5,3;

"SETUP PROGRAM FOR DICHOTOMOUS CHOICE CVM CONFIDENCE
INTERVALS";

PRINT;

"Answer the questions this program ask you. Your answers";

"will be saved (overwriting the answers from the previous run).";

"When you see the GAUSS prompt, type <RUN MVCONFID.PRG> to run the";

"confidence interval program.";

print;

"THE VARIANCE MATRIX, COEFFICIENT VECTOR";

"AND THE MEANS MUST ALL BE IN THE SAME ORDER,";

"WITH THE PRICE COEFFICIENT IN THE SECOND POSITION!!!";

print;
```

```
"enter the title";

title=cons;

"enter the number of independent variables";

k=con(1,1);

print;

"parameter vector first, enter the parameters in order";

params = con(k,1);

print;

"the coefficients are";

params;

print;

"now the means of the independent variables, in the same order as above";

means = con(k,1);

print;

"the means are";

means;

PRINT;

"now the var-cov matrix";

varcov=zeros(k,k);

i=1;

do until i > k;

j=i;
```

```

do until j > k;

"enter the ";i;",".;j;,"th element";

temp=con(1,1);

varcov[i,j] = temp;

j=j+1;

endo;

i=i+1;

endo;

varcov=varcov+varcov';

d=diag(varcov)/2;

varcov=diagrv(varcov,d);

print;

"the var-cov matrix is";

varcov;

save title,varcov, means,params;

cls;

"Everything is saved. Enter <RUN MVCONFID.PRG> now to get CI's";

end;

```

APPENDIX IC
GAUSS CODE FOR CONFIDENCE INTERVALS AROUND RESTRICTED
MEAN WILLINGNESS TO PAY

MEDCONFID.PRG

```
CLS;  
FORMAT 8,5;  
  
/* program medconfid.prg  
generates confidence intervals around median WTP for  
dichotomous choice CV  
with many independent variables */  
  
output file = mvsvjvci.out on;  
  
reps = 4000;  
  
/* defining conf int endpoints */  
let ii[2,1] = 21,3980;  
let jj[2,1] = 101,3900;
```

```

let kk[2,1] = 201.3800;

load cof = params,var = varcov, xbar = means;
loads title;

/* calculating the grand constant and its varcov
using the formula for a linear function of mvn random vector */

k=rows(cof);
r=zeros(2,k);
r[1,.]=r[1,.]+1;
r[1,2]=0;
r[1,.]=r[1,.]*xbar';
r[2,2]=1;
cof=r*cof;
var=r*var*r';
pp=chol(var);

/* make draws from mvn */
b = rndn(reps,rows(cof))*pp + cof;

/* calculate measure of interest for each replication */
cv = ((b[..1]))./(abs(b[..2]));

```

```

b=0;

cv = sortc(cv,1);

cls;

"*****";

"CONFIDENCE INTERVALS FOR DICHOTOMOUS CHOICE CV";

"*****";

$title;

print;

"Grand constant and price coefficients";

cof';

print;

"repetitions used to form CI's = ";;reps:

print;

"99 ci ";;cv[ii,'];

print;

"95 ci ";;cv[jj,'];

print;

"90 ci ";;cv[kk,'];

print;

cv=0;

end;

```

APPENDIX 2A
SURVEY TREATMENT 1

APPENDIX 2B
SURVEY TREATMENT 2

APPENDIX 2C
SURVEY TREATMENT 3

APPENDIX 2D
SURVEY TREATMENT 4

**Should Federal Lands
be Used to Provide
Habitat for Endangered Species?**



What do you think?

**Colorado
State
University**

Department of Agricultural and Resource Economics
Fort Collins, Colorado 80523

Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

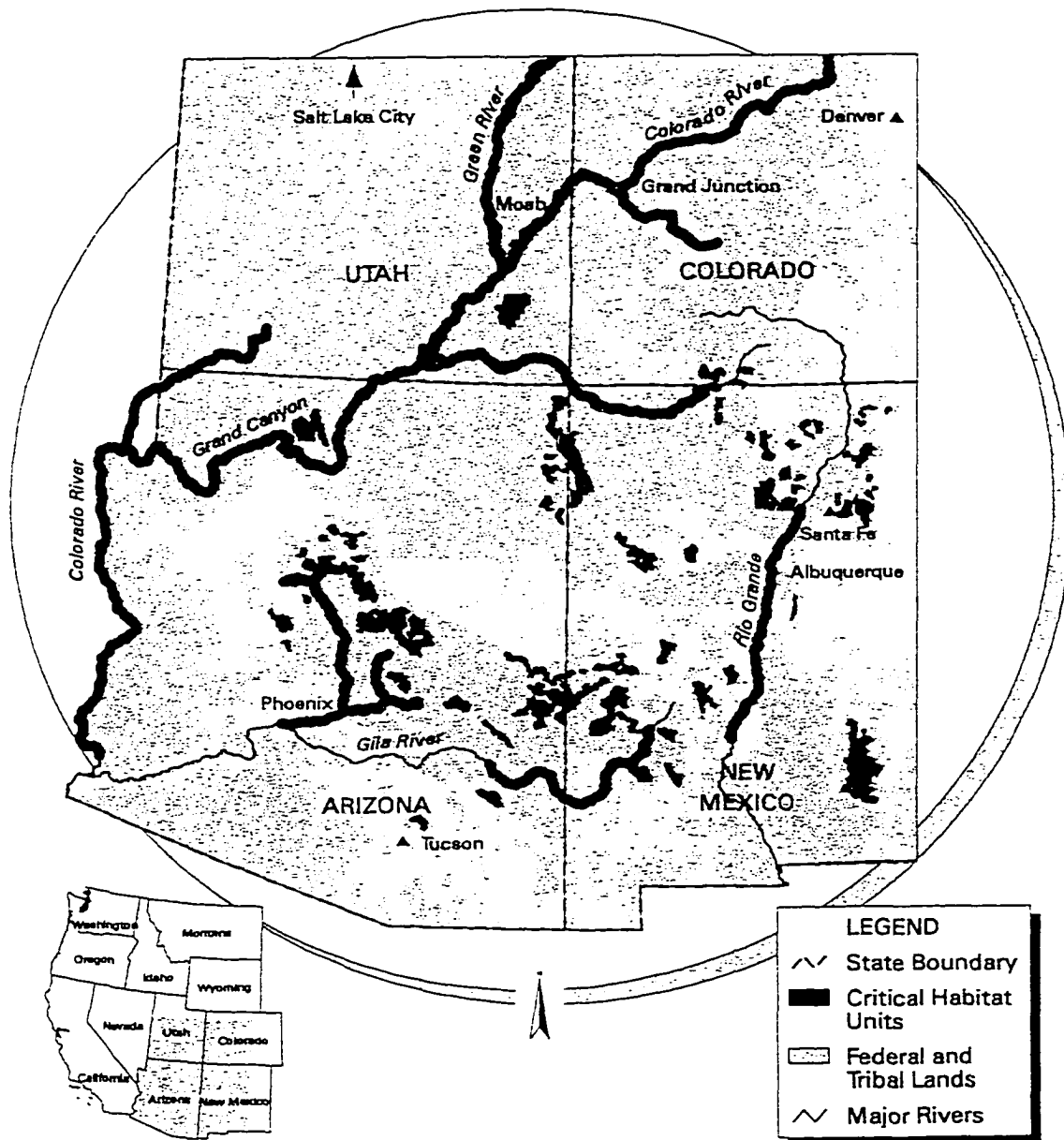


Figure 1
Survey Treatment 1: Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

Critical Habitat Units for the Mexican Spotted Owl

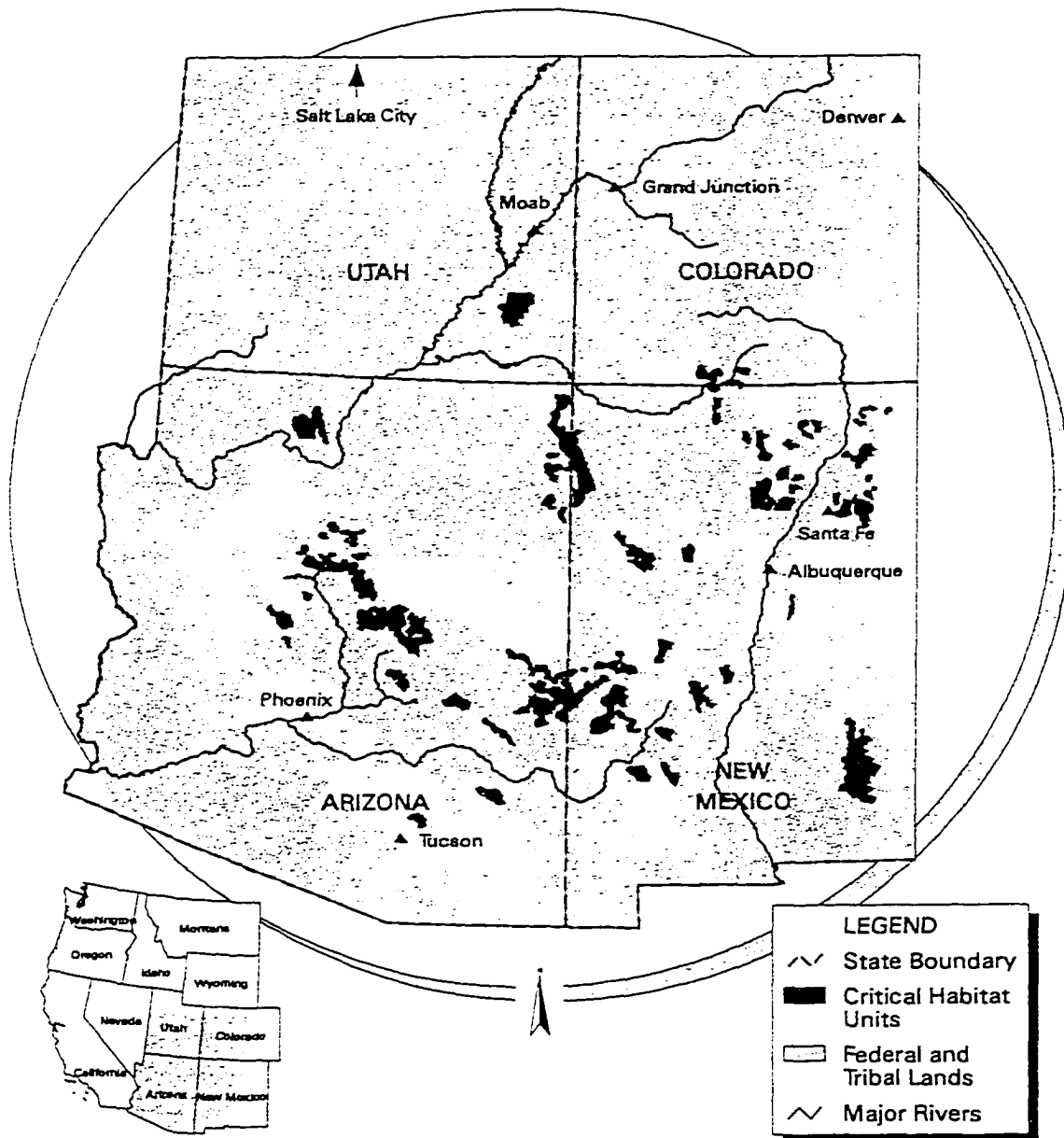


Figure 2
Survey Treatment 1: Critical Habitat Units for the Mexican Spotted Owl

SECTION I - Your Views on Endangered Species Management

People often have different views about environmental and economic issues. Please indicate your view by **CIRCLING ONE NUMBER FOR EACH STATEMENT.**

Note that a 1=strongly agree and 5= strongly disagree.

	<u>STRONGLY AGREE</u>		<u>NEUTRAL</u>		<u>STRONGLY DISAGREE</u>
Businesses should be allowed to extract natural resources from Federal lands.	1	2	3	4	5
All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being.	1	2	3	4	5
Plants and animals have as much right as humans to exist ...	1	2	3	4	5
I am glad that the endangered species in the Four Corners Region are protected even if I never see them.	1	2	3	4	5
If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large.	1	2	3	4	5
Protection of Threatened and Endangered Species is a responsibility I am willing to pay for.	1	2	3	4	5

Have you read or heard about threats to the Northern Spotted Owl in the Northwestern United States?

Yes No

Have you read or heard about threats to the Mexican Spotted Owl in the Southwestern United States?

Yes No

Have you read or heard about threatened and endangered fish in the Colorado River?

Yes No

SECTION II - Mexican Spotted Owl: A Threatened Species

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

Why is the Owl Threatened?

It is threatened due to clearcutting of old growth forests and loss of other habitat in the Four Corners Region, where this species primarily lives.

CURRENT MEXICAN SPOTTED OWL PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ 4.6 million acres of Federal Lands are being designated as Critical Habitat Units (CHUs) shown in green on the Mexican Spotted Owl map.
- ✓ Clearcutting is banned within the CHUs to protect the remaining old growth forests.
- ✓ Federal agencies are spending money to improve habitat through reforestation with native tree species and thinning of older tree farms. Thinning provides space for the remaining trees to grow large enough to become habitat for the Mexican Spotted Owl.

What is the Goal?

- ✓ A large enough recovery of owl populations so they are no longer Threatened.

What are the Costs?

- ✓ Lost timber production on Federal lands in the Four Corners Region.
- ✓ The costs to the Federal government of reforestation and thinning greatly exceed the value of the wood that can be selectively harvested in the future.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs of protecting the Mexican Spotted Owl are too high and propose to:

- ✓ *Eliminate:* funding for habitat improvements.
- ✓ *Eliminate:* Critical Habitat Units shown on the Mexican Spotted Owl map.
- ✓ *Allow:* clearcutting in old growth forests that are habitat for the Mexican Spotted Owl.

PROPOSAL TO FUND THE MEXICAN SPOTTED OWL PROGRAM

- ✓ Establish a Mexican Spotted Owl Recovery Federal Trust Fund to pay these costs.
- ✓ By law, the funds could *only* be used to improve habitat, such as reforestation.

Who Would Pay?

- ✓ Loggers cutting timber on other Federal lands in the Four Corners Region.
- ✓ Forest recreation users through entrance and camping fees in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) the Critical Habitat Units are on Federal lands such as National Forests; (b) sufficient revenues are needed for the Mexican Spotted Owl recovery program.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to **approve** funding the Current Program it would:

- ✓ Maintain 4.6 million acres of Critical Habitat Units shown on the Mexican Spotted Owl map.
- ✓ Fund habitat protection and improvements for the Mexican Spotted Owl.
- ✓ Provide for recovery of the owl population within 15 years so it would no longer be a Threatened Species.

If a majority of households in the U.S. vote to **not approve** the Current Program:

- ✓ The current program will be eliminated and Critical Habitat Units will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, mining, and grazing will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely the Mexican Spotted Owl will become extinct in 15 years.

Suppose a proposal to establish a Mexican Spotted Owl Recovery Federal Trust Fund was on the ballot in the next nationwide election. How would you vote on this proposal?

Remember, by law, the funds could *only* be used to improve habitat, such as reforestation.

1. If the Mexican Spotted Owl Recovery Trust Fund was the only issue on the next ballot and it would cost your household \$ 30 every year, would you vote in favor of it? (Please circle one.)

YES

NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted NO on the previous page, please answer the next question. (If you voted YES on the previous page, please go to Section III on the next page)

We are interested in the main reason you voted NO. Please read all the reasons and then check just the one, most important reason below.

_____ Protecting critical habitat for this species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve this species.

_____ I want the timber harvest to continue on these acres.

_____ I am opposed to paying for this government program.

_____ I do not believe that preserving Endangered and Threatened Species is important.

_____ Other, please explain:

Please continue with the next section

Management of Endangered Species on Federal Lands in the Four Corners Region

The management of endangered species on Federal Lands is a much debated topic these days. Your views on this topic are an important part of this debate. Before you answer we want to clarify what we mean by Federal Lands and endangered species.

The Federal Endangered Species Act requires protection for Threatened and Endangered Species, including over 65 mammals, 90 birds, 101 fishes, 168 "other species" (such as salamanders, spiders, clams, shrimp, butterflies, turtles, and snails), and 468 plants. Prevention of extinction often requires preserving the habitat necessary for survival.

In this survey we use the following terms:

Endangered Species: are federally listed species that are in danger of extinction within the foreseeable future on a significant portion of their habitat.

Threatened Species: are federally listed species that are likely to become endangered within the foreseeable future on a significant portion of their habitat.

Threatened and Endangered List: is the list of species which are designated by the U.S. Fish and Wildlife Service as Threatened or Endangered.

Critical Habitat Units (CHUs): Land designated by the U.S. Fish and Wildlife Service as crucial for the survival of the species or unoccupied habitat necessary for recovery of the species. Usually some human activity is restricted on these acres. For instance, in forests, timber harvesting and grazing may be restricted.

Federal lands include National Forests, National Parks, lands administered by the Bureau of Land Management and Indian Reservations. These lands total about 136 million acres in the Four Corners Region.

The **Four Corners Region** is Arizona, Southwestern Colorado, Western New Mexico, and Southeastern Utah. This area is known as the "Four Corners" because the borders of these four states meet at this point.

What Benefits Might Threatened and Endangered Species Provide?

While it is difficult to identify the benefit of each individual Threatened and Endangered Species, as a group they provide the following benefits to humans:

1. Indicators of the health of the environment where people live (many species are more sensitive to pollution than humans, so species often serve as an early warning system about rising pollution levels).
2. Potential sources of medicines and substances for industrial and commercial use.
3. Act as stabilizers maintaining a balance among predators and prey so as not to have population explosions of one species or pest.
4. Protecting diversity of species.

SECTION III - Threatened and Endangered Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

62 Threatened and Endangered Species found only in the Four Corners Region are at risk of extinction. These include fish, birds, mammals, and plants. These are shown in Figure 1 on the next page.

Why are these Species Threatened and Endangered?

Populations of these 62 Threatened and Endangered Species are declining due to a loss of habitat from clearcutting, livestock grazing, mining, damming, and water diversions from rivers. Also, populations are affected by the introduction of non-native species to the habitat.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ Designation of Critical Habitat Units shown in green on the Threatened and Endangered Species map:
 - 4.6 million acres of Federal Lands.
 - 2,456 miles of rivers in the Four Corners Region.
 - This limits clearcutting, mining, and grazing on these lands.
- ✓ Federal hydroelectric dam operators must release water to imitate natural water flows needed by the fish rather than maximize the value of electricity production.
- ✓ Federal agencies are implementing programs to improve habitats.

What is the Goal?

- ✓ To prevent extinction of these 62 species and promote a large enough recovery of their populations so they are no longer Threatened and Endangered.

What are the Costs?

- ✓ A reduction in timber harvest, electricity production, livestock grazing, and mining in the Four Corners Region.
- ✓ Implementing programs to improve habitats costs money.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs to protect these 62 Threatened and Endangered Species are too high and they propose to:

- ✓ *Eliminate:* funding for habitat improvements for the 62 Threatened and Endangered Species in the Four Corners Region.
- ✓ *Eliminate:* Critical Habitat Units for the 62 species as shown on the Threatened and Endangered Species map.
- ✓ *Allow:* clearcutting, grazing, and mining in the Critical Habitat Units in Four Corners Region.

(Note: These proposals are limited to the Four Corners Region shown on the map and would not reduce protection of other Threatened and Endangered Species in the remaining 46 states.)

What Would Happen to Populations of Threatened and Endangered Species in the Four Corners Region if these Changes are Made?

It is very likely that *half* of the 62 Threatened and Endangered Species listed in Figure 1 would become extinct in the next 15 years.

The following chart (Figure 1) shows the 25 different types of Threatened Species and 37 different types of Endangered Species found only in the Four Corners Region and nowhere else in the United States.

Figure 1: Types of Threatened and Endangered Species Found Only in the Four Corners Region

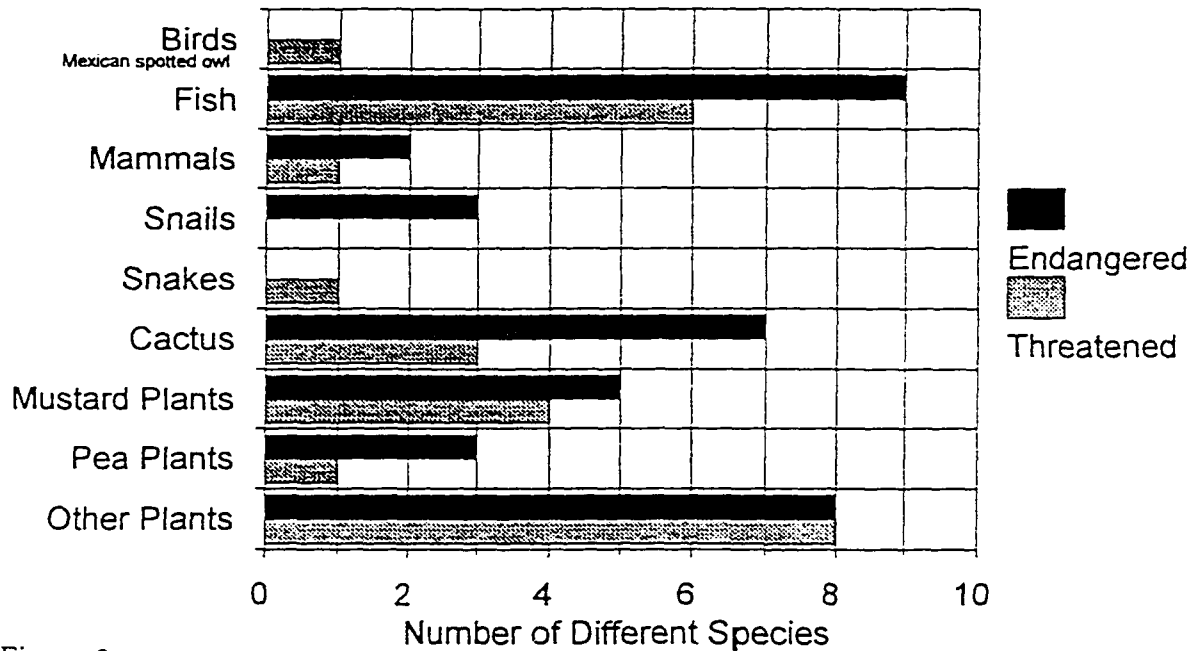


Figure 3
Survey Treatment 1: Types of Threatened and Endangered Species Found Only in the Four Corners Region

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Species Trust Fund** to pay the costs.
- ✓ By law, the funds could *only* be used to improve habitat.

Who Would Pay?

- ✓ Loggers, miners, and others using natural resources from Federal Lands in the Four Corners Region.
- ✓ Visitors to National Forests and Parks in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) most Critical Habitat Units are on Federal land; (b) dams adversely affecting these species are Federally owned and managed; and (c) sufficient revenues are needed for the recovery program for these species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to approve funding the Current Program it would:

- ✓ Maintain Critical Habitat Units shown on the Threatened and Endangered Species map.
- ✓ Fund habitat protection and improvements for all 62 species.
- ✓ Purchase of water rights to maintain instream flows for fish and other species.
- ✓ Save the 37 Endangered Species from extinction and increase the populations of the 25 Threatened Species so that they would no longer be listed as Threatened within 15 years.

If a majority of households in the U.S. vote to not approve the Current Program:

- ✓ The Current Program will be eliminated and Critical Habitat Units shown on the map will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, grazing, and mining will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely that *half* of these 62 species in Figure 1 will become extinct in 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Species Trust Fund was on the ballot in the next nationwide election.

Remember, by law, the funds could *only* be used to improve habitat.

1. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$ 50 every year, would you vote in favor of it?

YES NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted NO on the previous page, please answer the next question. (If you voted YES on the previous page, please go to Section IV on the next page)

We are interested in the main reason you voted NO. Please read all the reasons and then check just the one, most important reason below.

_____ Protecting critical habitat for these species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve these species.

_____ I want the use of resources to continue on these lands and rivers.

_____ I am opposed to paying for government programs.

_____ I do not believe that preserving Endangered and Threatened Species is important.

_____ Other, please explain:

Please continue with the next section

Thank You for Completing the Survey!

If you have any additional thoughts on endangered species or critical habitat management, please feel free to write them down on the back cover. When you are finished, please put the survey in our **stamped** return envelope and mail it back to us.

APPENDIX 2B
SURVEY TREATMENT 2

**Should Federal Lands
be Used to Provide
Habitat for Endangered Species?**



What do you think?

**Colorado
State**
University

Department of Agricultural and Resource Economics
Fort Collins, Colorado 80523

Management of Endangered Species on Federal Lands in the Four Corners Region

The management of endangered species on Federal Lands is a much debated topic these days. Your views on this topic are an important part of this debate. Before you answer we want to clarify what we mean by Federal Lands and endangered species.

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Threatened and Endangered List: is the list of species which are designated by the U.S. Fish and Wildlife Service as Threatened or Endangered.

Critical Habitat Units (CHUs): Land designated by the U.S. Fish and Wildlife Service as crucial for the survival of the species or unoccupied habitat necessary for recovery of the species. Usually some human activity is restricted on these acres. For instance, in forests, timber harvesting and grazing may be restricted.

Federal lands include National Forests, National Parks, lands administered by the Bureau of Land Management and Indian Reservations. These lands total about 136 million acres in the Four Corners Region.

The **Four Corners Region** is Arizona, Southwestern Colorado, Western New Mexico, and Southeastern Utah. This area is known as the "Four Corners" because the borders of these four states meet at this point.

What Benefits Might Threatened and Endangered Species Provide?

While it is difficult to identify the benefit of each individual Threatened and Endangered Species, as a group they provide the following benefits to humans:

1. Indicators of the health of the environment where people live (many species are more sensitive to pollution than humans, so species often serve as an early warning system about rising pollution levels).
2. Potential sources of medicines and substances for industrial and commercial use.
3. Act as stabilizers maintaining a balance among predators and prey so as not to have population explosions of one species or pest.
4. Protecting diversity of species.

Critical Habitat Units for the Mexican Spotted Owl

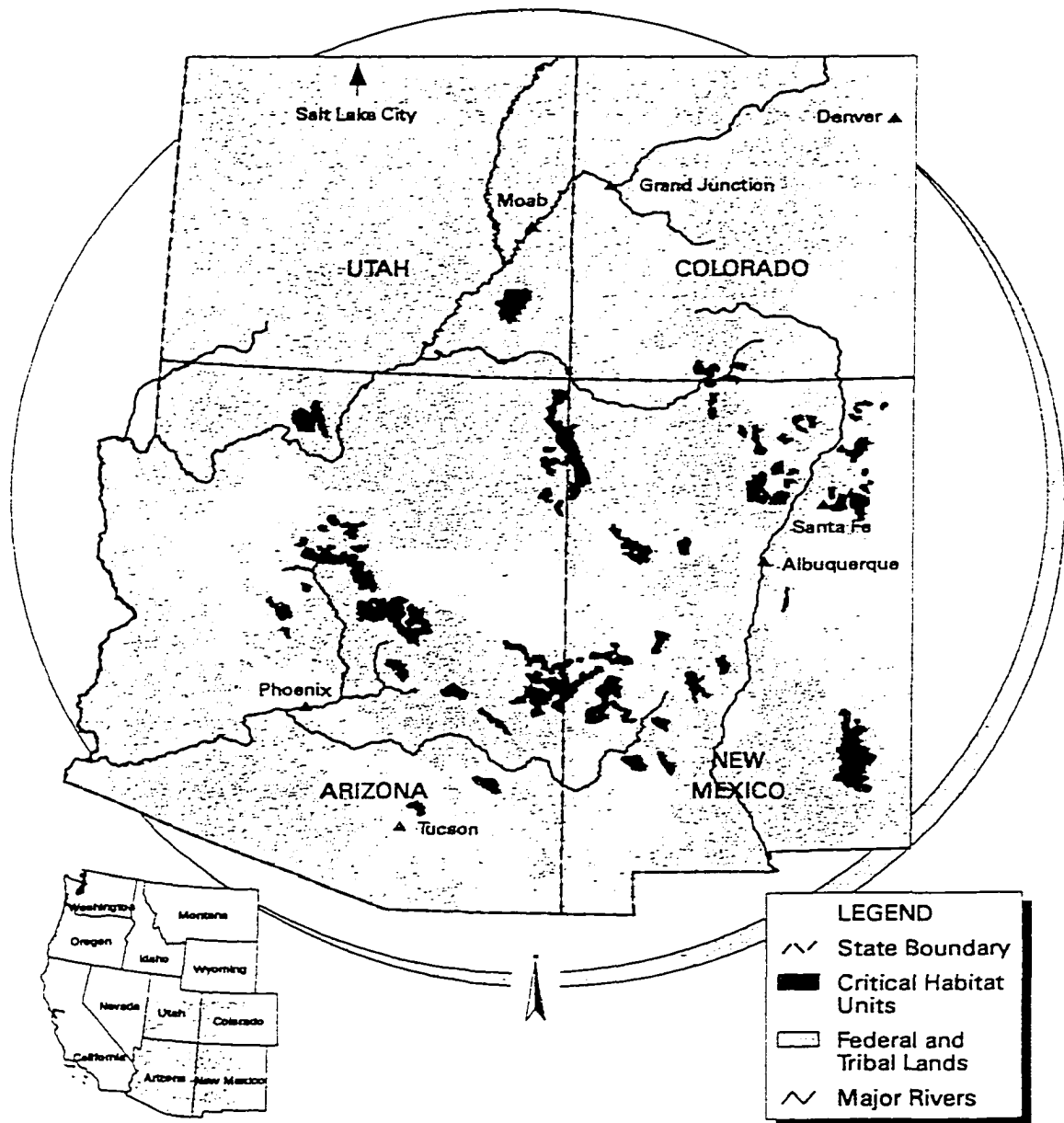


Figure 4
Survey Treatment 2: Critical Habitat Units for Threatened and Endangered Species
in the Four Corners Region

Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

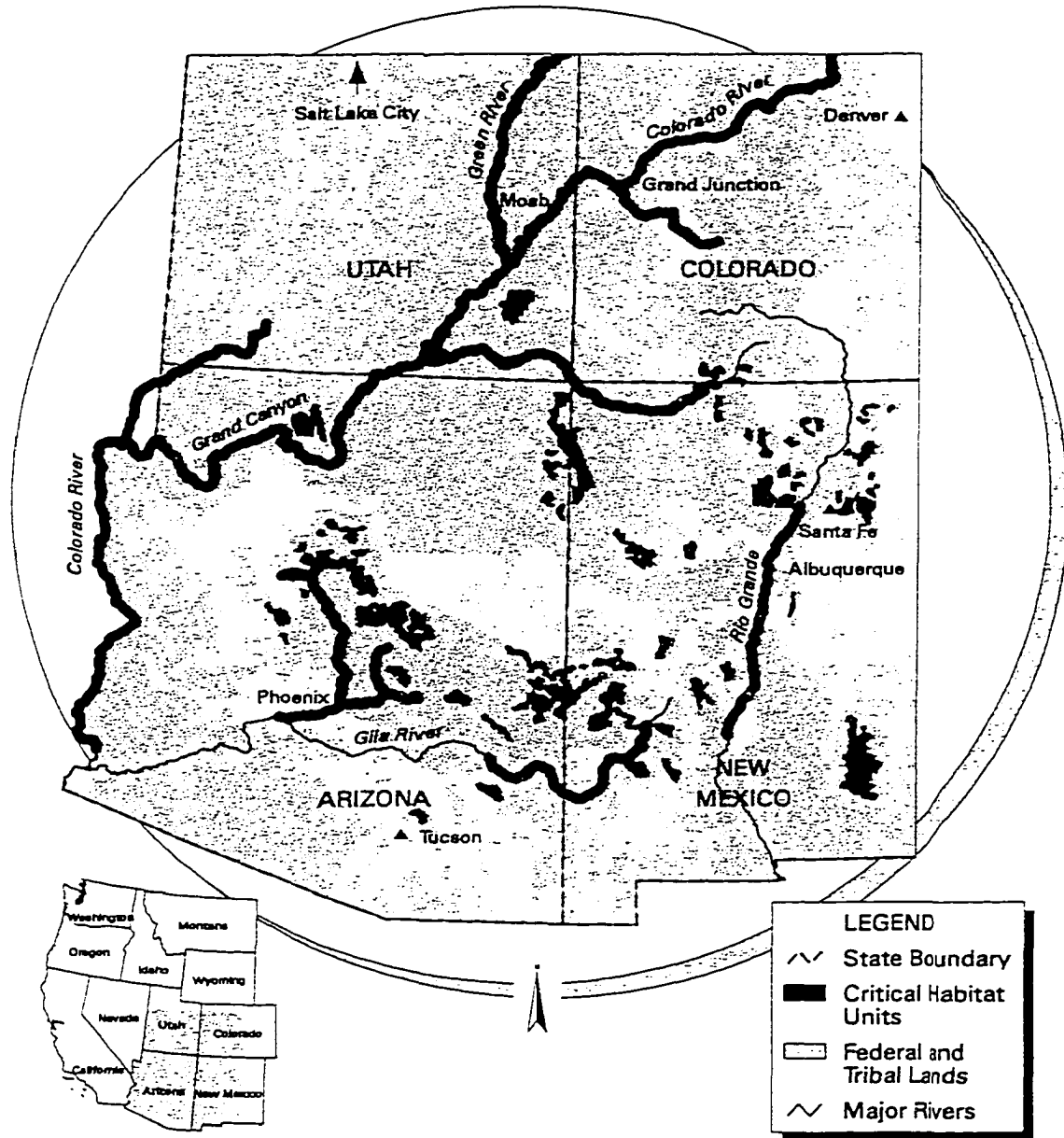


Figure 5
Survey Treatment 2: Critical Habitat Units for the Mexican Spotted Owl

SECTION I - Threatened and Endangered Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

62 Threatened and Endangered Species found only in the Four Corners Region are at risk of extinction. These include fish, birds, mammals, and plants. These are shown in Figure 1 on the next page.

Why are these Species Threatened and Endangered?

Populations of these 62 Threatened and Endangered Species are declining due to a loss of habitat from clearcutting, livestock grazing, mining, damming, and water diversions from rivers. Also, populations are affected by the introduction of non-native species to the habitat.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ Designation of Critical Habitat Units shown in green on the Threatened and Endangered Species map:
 - 4.6 million acres of Federal Lands.
 - 2,456 miles of rivers in the Four Corners Region.
 - This limits clearcutting, mining, and grazing on these lands.
- ✓ Federal hydroelectric dam operators must release water to imitate natural water flows needed by the fish rather than maximize the value of electricity production.
- ✓ Federal agencies are implementing programs to improve habitats.

What is the Goal?

- ✓ To prevent extinction of these 62 species and promote a large enough recovery of their populations so they are no longer Threatened and Endangered.

What are the Costs?

- ✓ A reduction in timber harvest, electricity production, livestock grazing, and mining in the Four Corners Region.
- ✓ Implementing programs to improve habitats costs money.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs to protect these 62 Threatened and Endangered Species are too high and they propose to:

- ✓ *Eliminate:* funding for habitat improvements for the 62 Threatened and Endangered Species in the Four Corners Region.
- ✓ *Eliminate:* Critical Habitat Units for the 62 species as shown on the Threatened and Endangered Species map.
- ✓ *Allow:* clearcutting, grazing, and mining in the Critical Habitat Units in Four Corners Region.

(Note: These proposals are limited to the Four Corners Region shown on the map and would not reduce protection of other Threatened and Endangered Species in the remaining 46 states.)

What Would Happen to Populations of Threatened and Endangered Species in the Four Corners Region if these Changes are Made?

It is very likely that *half* of the 62 Threatened and Endangered Species listed in Figure 1 would become extinct in the next 15 years.

The following chart (Figure 1) shows the 25 different types of Threatened Species and 37 different types of Endangered Species found only in the Four Corners Region and nowhere else in the United States.

Figure 1: Types of Threatened and Endangered Species Found Only in the Four Corners Region

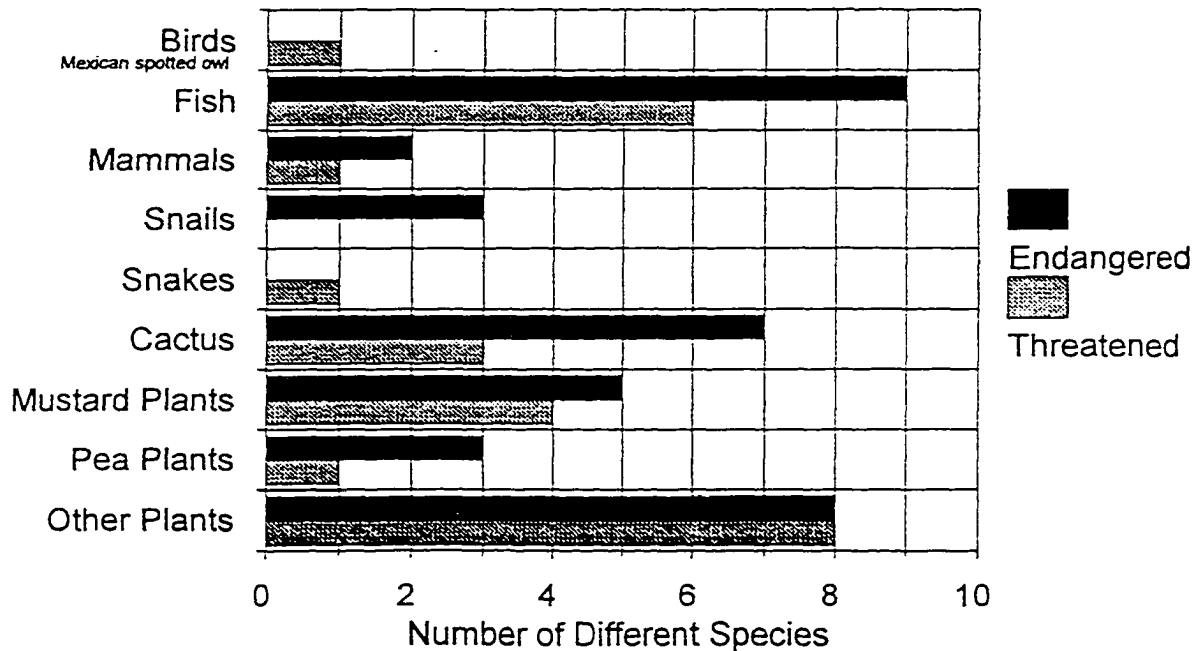


Figure 6
Survey Treatment 2: Types of Threatened and Endangered Species Found Only in the Four Corners Region

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Species Trust Fund** to pay the costs.
- ✓ By law, the funds could *only* be used to improve habitat.

Who Would Pay?

- ✓ Loggers, miners, and others using natural resources from Federal Lands in the Four Corners Region.
- ✓ Visitors to National Forests and Parks in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) most Critical Habitat Units are on Federal land; (b) dams adversely affecting these species are Federally owned and managed; and (c) sufficient revenues are needed for the recovery program for these species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to approve funding the Current Program it would:

- ✓ Maintain Critical Habitat Units shown on the Threatened and Endangered Species map.
- ✓ Fund habitat protection and improvements for all 62 species.
- ✓ Purchase of water rights to maintain instream flows for fish and other species.
- ✓ Save the 37 Endangered Species from extinction and increase the populations of the 25 Threatened Species so that they would no longer be listed as Threatened within 15 years.

If a majority of households in the U.S. vote to not approve the Current Program:

- ✓ The Current Program will be eliminated and Critical Habitat Units shown on the map will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, grazing, and mining will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely that *half* of these 62 species in Figure 1 will become extinct in 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Species Trust Fund was on the ballot in the next nationwide election.

Remember, by law, the funds could *only* be used to improve habitat.

1. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$ 30 every year, would you vote in favor of it?

YES NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted NO on the previous page, please answer the next question. (If you voted YES on the previous page, please go to Section IV on the next page)

We are interested in the main reason you voted NO. Please read all the reasons and then check just the *one*, most important reason below.

_____ Protecting critical habitat for these species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve these species.

_____ I want the use of resources to continue on these lands and rivers.

_____ I am opposed to paying for government programs.

_____ I do not believe that preserving Endangered and Threatened Species is important.

_____ Other, please explain:

Please continue with the next section

SECTION II - Your Views on Endangered Species Management

People often have different views about environmental and economic issues. Please indicate your view by **CIRCLING ONE NUMBER FOR EACH STATEMENT.**

Note that a 1=strongly agree and 5= strongly disagree.

	<u>STRONGLY AGREE</u>		<u>NEUTRAL</u>		<u>STRONGLY DISAGREE</u>
Businesses should be allowed to extract natural resources from Federal lands.	1	2	3	4	5
All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being.	1	2	3	4	5
Plants and animals have as much right as humans to exist. ...	1	2	3	4	5
I am glad that the endangered species in the Four Corners Region are protected even if I never see them.	1	2	3	4	5
If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large.	1	2	3	4	5
Protection of Threatened and Endangered Species is a responsibility I am willing to pay for.	1	2	3	4	5

Have you read or heard about threats to the Northern Spotted Owl in the Northwestern United States?

Yes No

Have you read or heard about threats to the Mexican Spotted Owl in the Southwestern United States?

Yes No

Have you read or heard about threatened and endangered fish in the Colorado River?

Yes No

SECTION III - Mexican Spotted Owl: A Threatened Species

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

Why is the Owl Threatened?

It is threatened due to clearcutting of old growth forests and loss of other habitat in the Four Corners Region, where this species primarily lives.

CURRENT MEXICAN SPOTTED OWL PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ 4.6 million acres of Federal Lands are being designated as Critical Habitat Units (CHUs) shown in green on the Mexican Spotted Owl map.
- ✓ Clearcutting is banned within the CHUs to protect the remaining old growth forests.
- ✓ Federal agencies are spending money to improve habitat through reforestation with native tree species and thinning of older tree farms. Thinning provides space for the remaining trees to grow large enough to become habitat for the Mexican Spotted Owl.

What is the Goal?

- ✓ A large enough recovery of owl populations so they are no longer Threatened.

What are the Costs?

- ✓ Lost timber production on Federal lands in the Four Corners Region.
- ✓ The costs to the Federal government of reforestation and thinning greatly exceed the value of the wood that can be selectively harvested in the future.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs of protecting the Mexican Spotted Owl are too high and propose to:

- ✓ *Eliminate:* funding for habitat improvements.
- ✓ *Eliminate:* Critical Habitat Units shown on the Mexican Spotted Owl map.
- ✓ *Allow:* clearcutting in old growth forests that are habitat for the Mexican Spotted Owl.

What Would Happen to the Mexican Spotted Owl if These Changes are Made?

Biologists expect this species would become extinct in the next 15 years.

PROPOSAL TO FUND THE MEXICAN SPOTTED OWL PROGRAM

- ✓ Establish a Mexican Spotted Owl Recovery Federal Trust Fund to pay these costs.
- ✓ By law, the funds could *only* be used to improve habitat, such as reforestation.

Who Would Pay?

- ✓ Loggers cutting timber on other Federal lands in the Four Corners Region.
- ✓ Forest recreation users through entrance and camping fees in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) the Critical Habitat Units are on Federal lands such as National Forests; (b) sufficient revenues are needed for the Mexican Spotted Owl recovery program.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to **approve** funding the Current Program it would:

- ✓ Maintain 4.6 million acres of Critical Habitat Units shown on the Mexican Spotted Owl map.
- ✓ Fund habitat protection and improvements for the Mexican Spotted Owl.
- ✓ Provide for recovery of the owl population within 15 years so it would no longer be a Threatened Species.

If a majority of households in the U.S. vote to **not approve** the Current Program:

- ✓ The current program will be eliminated and Critical Habitat Units will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, mining, and grazing will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely the Mexican Spotted Owl will become extinct in 15 years.

Suppose a proposal to establish a Mexican Spotted Owl Recovery Federal Trust Fund was on the ballot in the next nationwide election. How would you vote on this proposal?

Remember, by law, the funds could *only* be used to improve habitat, such as reforestation.

1. If the Mexican Spotted Owl Recovery Trust Fund was the only issue on the next ballot and it would cost your household \$ 30 every year, would you vote in favor of it?

YES NO

SECTION IV - About You: These last few questions will help us in evaluating the representativeness of our sample. **Your answers are strictly confidential and will only be used for the analysis of this study. You will not be identified in any way.**

1. Are you: Male Female
2. What is your age: Years
3. What is your zip code?
4. How long have you lived within your current state of residence? Years
5. A: Do you live in the Four Corners Region? Yes No
 (Arizona, Southwestern Colorado, Western New Mexico, or Southeastern Utah)
- B: If NO, have you visited the Four Corners Region of the U.S. Yes No
6. Have you visited a National Forest or National Park
 in the Four Corners Region in the past 12 months? Yes No
7. During the past 12 months, have you been:

bird watching?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
fishing?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
hiking or camping?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8. Are you a member of a conservation or environmental organization? Yes No
9. What is your occupation? _____
10. Did you vote in the last national election? Yes No
11. Highest level of formal schooling? (Please circle one)

1 2 3 4 5 6	7 8 9	10 11 12	13 14 15 16	17 18 19 20 21+
(Elementary)	(Jr. High)	(High School)	(College or Technical School)	(Graduate or Professional School)
12. How many members are in your household? people
13. How many contribute to paying the household expenses? people
14. Including these people, approximately what was your household income from all sources (before taxes)
 last year?

<input type="text"/> less than \$10,000	<input type="text"/> \$40,000 to \$49,999	<input type="text"/> \$80,000 to \$89,999
<input type="text"/> \$10,000 to \$19,999	<input type="text"/> \$50,000 to \$59,999	<input type="text"/> \$90,000 to \$99,999
<input type="text"/> \$20,000 to \$29,999	<input type="text"/> \$60,000 to \$69,999	<input type="text"/> \$100,000 to \$149,999
<input type="text"/> \$30,000 to \$39,999	<input type="text"/> \$70,000 to \$79,999	<input type="text"/> over \$150,000

Thank You for Completing the Survey!

If you have any additional thoughts on endangered species or critical habitat management, please feel free to write them down on the back cover. When you are finished, please put the survey in our **stamped** return envelope and mail it back to us.

APPENDIX 2C
SURVEY TREATMENT 3

**Should Federal Lands
be Used to Provide
Habitat for Endangered Species?**



What do you think?

**Colorado
State**
University

Department of Agricultural and Resource Economics
Fort Collins, Colorado 80523

Management of Endangered Species on Federal Lands in the Four Corners Region

The management of endangered species on Federal Lands is a much debated topic these days. Your views on this topic are an important part of this debate. Before you answer we want to clarify what we mean by Federal Lands and endangered species.

The Federal Endangered Species Act requires protection for Threatened and Endangered Species, including over 65 mammals, 90 birds, 101 fishes, 168 "other species" (such as salamanders, spiders, clams, shrimp, butterflies, turtles, and snails), and 468 plants. Prevention of extinction often requires preserving the habitat necessary for survival.

In this survey we use the following terms:

Endangered Species: are federally listed species that are in danger of extinction within the foreseeable future on a significant portion of their habitat.

Threatened Species: are federally listed species that are likely to become endangered within the foreseeable future on a significant portion of their habitat.

Threatened and Endangered List: is the list of species which are designated by the U.S. Fish and Wildlife Service as Threatened or Endangered.

Critical Habitat Units (CHUs): Land designated by the U.S. Fish and Wildlife Service as crucial for the survival of the species or unoccupied habitat necessary for recovery of the species. Usually some human activity is restricted on these acres. For instance, in forests, timber harvesting and grazing may be restricted.

Federal lands include National Forests, National Parks, lands administered by the Bureau of Land Management and Indian Reservations. These lands total about 136 million acres in the Four Corners Region.

The **Four Corners Region** is Arizona, Southwestern Colorado, Western New Mexico, and Southeastern Utah. This area is known as the "Four Corners" because the borders of these four states meet at this point.

What Benefits Might Threatened and Endangered Species Provide?

While it is difficult to identify the benefit of each individual Threatened and Endangered Species, as a group they provide the following benefits to humans:

1. Indicators of the health of the environment where people live (many species are more sensitive to pollution than humans, so species often serve as an early warning system about rising pollution levels).
2. Potential sources of medicines and substances for industrial and commercial use.
3. Act as stabilizers maintaining a balance among predators and prey so as not to have population explosions of one species or pest.
4. Protecting diversity of species.

Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

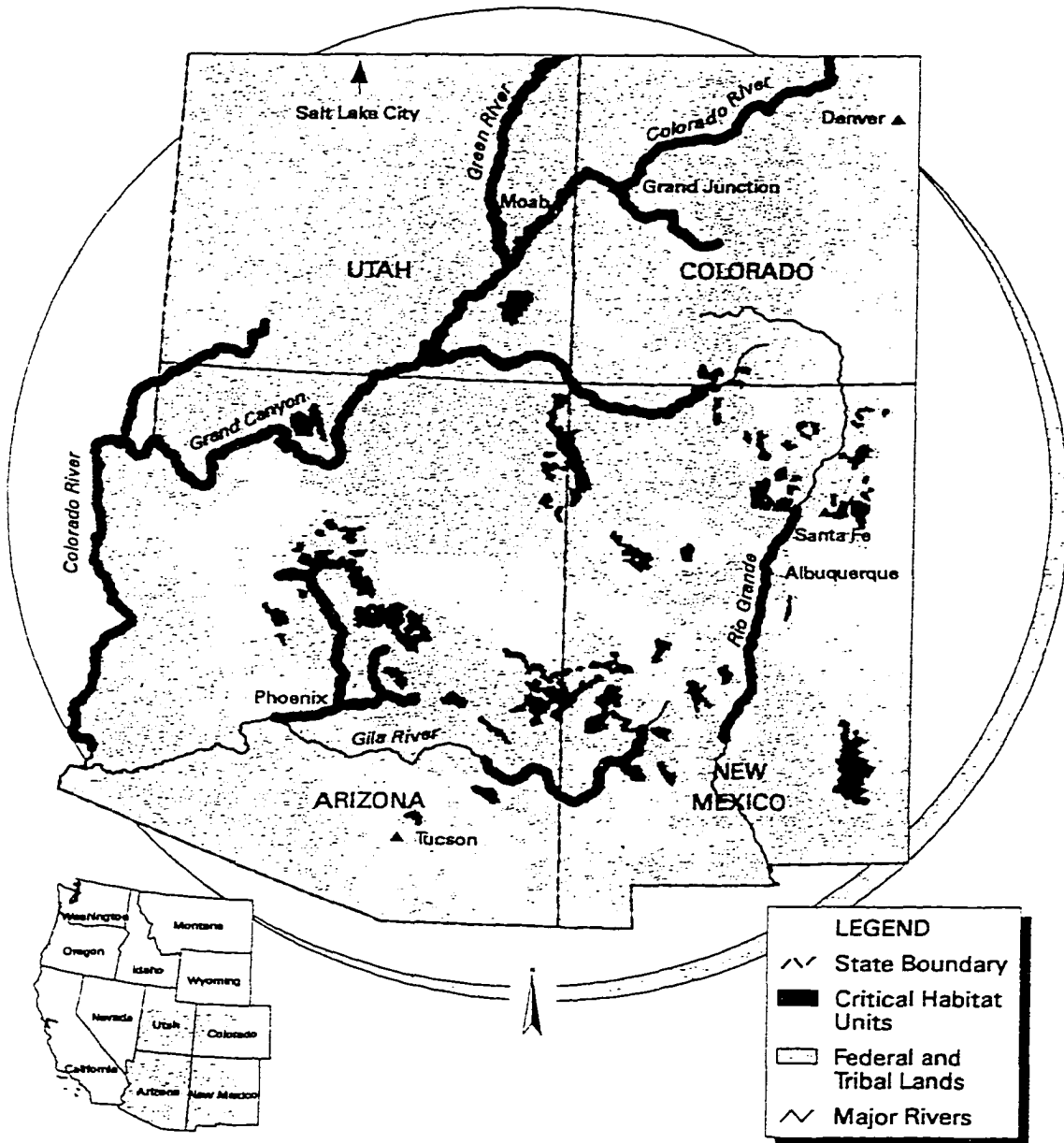


Figure 7
 Survey Treatment 3: Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

Critical Habitat Units for Threatened and Endangered Fish Species in the Four Corners Region

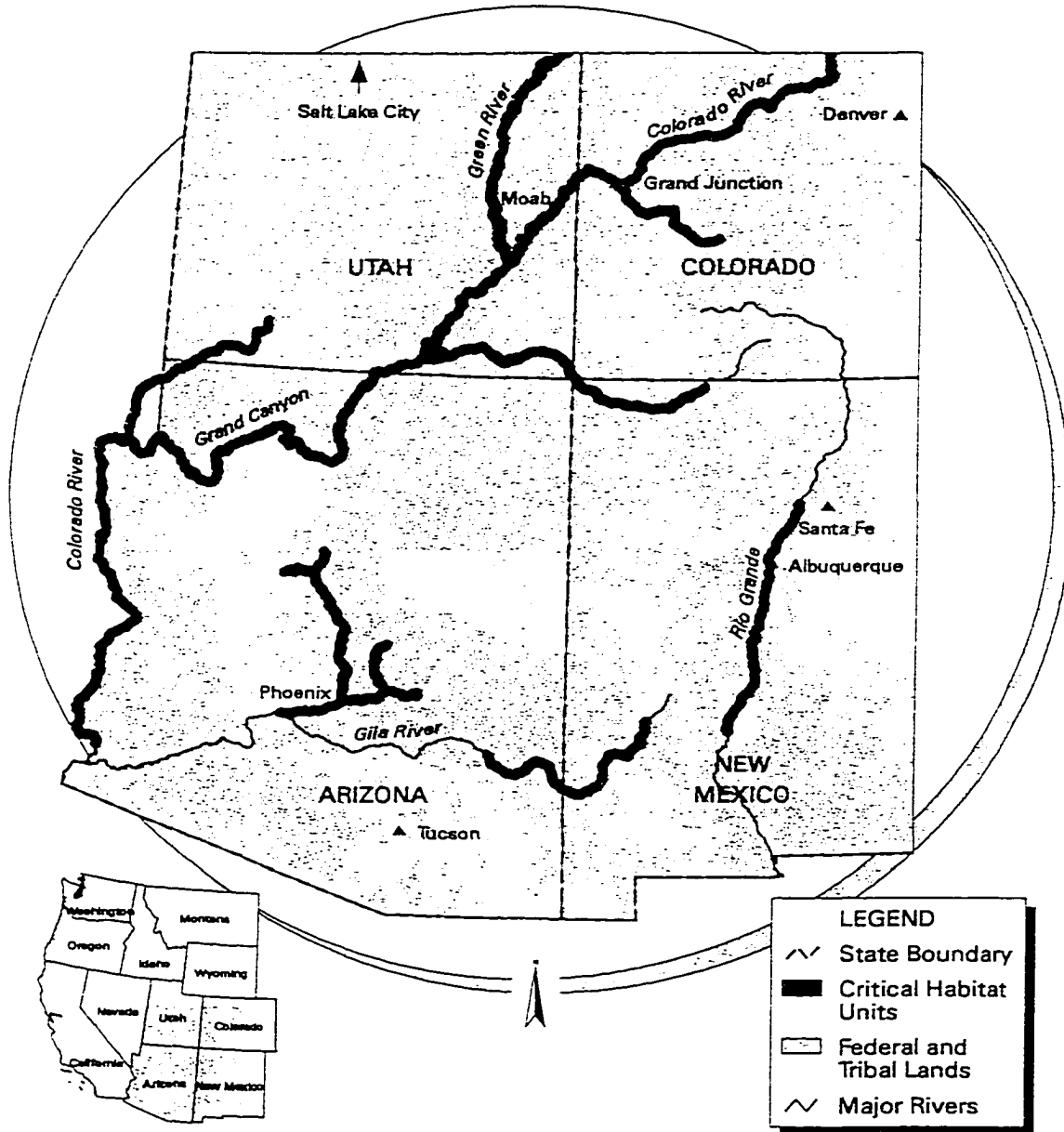


Figure 8
 Survey Treatment 3: Critical Habitat Units for Threatened and Endangered Fish Species in the Four Corners Region

SECTION I - Your Views on Endangered Species Management

People often have different views about environmental and economic issues. Please indicate your view by **CIRCLING ONE NUMBER FOR EACH STATEMENT.**

Note that a 1=strongly agree and 5= strongly disagree.

	<u>STRONGLY AGREE</u>		<u>NEUTRAL</u>		<u>STRONGLY DISAGREE</u>
Businesses should be allowed to extract natural resources from Federal lands.	1	2	3	4	5
All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being.	1	2	3	4	5
Plants and animals have as much right as humans to exist. ...	1	2	3	4	5
I am glad that the endangered species in the Four Corners Region are protected even if I never see them.	1	2	3	4	5
If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large.	1	2	3	4	5
Protection of Threatened and Endangered Species is a responsibility I am willing to pay for.	1	2	3	4	5

Have you read or heard about threats to the Northern Spotted Owl in the Northwestern United States?

Yes No

Have you read or heard about threats to the Mexican Spotted Owl in the Southwestern United States?

Yes No

Have you read or heard about threatened and endangered fish in the Colorado River?

Yes No

SECTION II - Threatened and Endangered Fish Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

The enclosed Threatened and Endangered Fish Map highlights in green the sections of major rivers that are or are being proposed as Critical Habitat Units for nine Threatened or Endangered fish species that live in the following rivers:

<u>Colorado River</u>	<u>San Juan and Green Rivers</u>	<u>Virgin River, UT</u>	<u>Gila River, AZ, NM</u>	<u>Rio Grande, NM</u>
Bonytail Chub	Colorado Squawfish	Virgin River Chub	Loach Minnow	Silvery Minnow
Colorado Squawfish	Razorback Sucker	Woundfin	Spikedace	
Humpback Chub				
Razorback Sucker				

Why are these Fish Threatened or Endangered?

- ✓ Diversion of streams for irrigation reduces fish habitat.
- ✓ Hydroelectric and other dams change the temperature and natural flow of the rivers as well as block the natural movement of the fish.
- ✓ Introduction of non-native species.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ 2,456 miles of river shown in green on the Threatened and Endangered Fish map are designated Critical Habitat Units.
- ✓ Federal hydroelectric and other dam operators must release water from the dams at critical locations to imitate natural water flows needed by the fish rather than maximize electricity production.
- ✓ Fish habitat is being improved and fish passageways are being constructed around diversion dams.

What is the Goal?

Prevent extinction and increase populations to the point they are no longer threatened or endangered.

What are the Costs?

- ✓ Reduced hydropower revenue to the Federal government.
- ✓ Construction costs for the fish passageways.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs of protecting these Nine Threatened and Endangered fish species are too high and propose to:

- ✓ *Eliminate:* Critical Habitat Unit protection on the 2,456 miles of river.
- ✓ *Allow:* Federal dam operators to time water releases to maximize hydropower.
(Note, these proposals are limited to the rivers in the Four Corners Region shown on the map and would not reduce protection of Threatened and Endangered species in the other 46 states).

What Would Happen to the Nine Threatened and Endangered Fish Species if These Changes are Made?

It is very likely that *four* of the nine fish species listed above would become extinct in the next 15 years.

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Fish Trust Fund** to pay these costs.
- ✓ Funds could *only* be used to protect and improve habitat for fish.

Who Would Pay?

- ✓ Irrigators diverting water from rivers in the Four Corners Region.
- ✓ River and reservoir recreation users through entrance and camping fees in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) the dams adversely affecting the nine fish are Federally owned and managed; (b) most Critical Habitat Units are on Federal lands; (c) sufficient revenues are needed for the recovery program for the nine fish species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to **approve** funding the Current Program it would:

- ✓ Maintain Critical Habitat Units for the nine Threatened and Endangered fish species to avoid extinction.
- ✓ Provide water releases from Federal dams timed to benefit fish.
- ✓ Purchase water rights to maintain instream flows on the rivers shown in green on the Threatened and Endangered Fish map.
- ✓ Within the next 15 years, three fish species would increase in population to the point they would no longer be listed as Threatened species.

If a majority of households in the U.S. vote to **not approve** the Current Program:

- ✓ The Critical Habitat Units shown on the Threatened and Endangered Fish map would be eliminated.
- ✓ No habitat improvements would occur.
- ✓ Water diversion activities and maximum power production would occur, reducing the amount of habitat for these nine fish species.
- ✓ Biologists estimate that it is very likely that *four* of the nine fish species will become extinct in the next 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Fish Trust Fund was on the ballot in the next nationwide election. How would you vote on this proposal?

Remember, by law, funds could *only* be used to protect and improve habitat for fish.

1. If the Four Corners Region Threatened and Endangered Fish Trust Fund was the only issue on the next ballot and it would cost your household \$ 75 every year, would you vote in favor of it?

YES NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted **NO** on the previous page, please answer the next question. (If you voted **YES** on the previous page, please go to Section III on the next page)

We are interested in the main reason you voted **NO**. Please read all the reasons and then check just the one, most important reason below.

_____ Protecting critical habitat for these species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve these species.

_____ I want the use of resources to continue on these rivers.

_____ I am opposed to paying for this government program.

_____ I do not believe that preserving endangered or threatened species is important.

_____ Other, please explain:

Please continue with the next section

SECTION III - Threatened and Endangered Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

62 Threatened and Endangered Species found only in the Four Corners Region are at risk of extinction. These include fish, birds, mammals, and plants. These are shown in Figure 1 on the next page.

Why are these Species Threatened and Endangered?

Populations of these 62 Threatened and Endangered Species are declining due to a loss of habitat from clearcutting, livestock grazing, mining, damming, and water diversions from rivers. Also, populations are affected by the introduction of non-native species to the habitat.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ Designation of Critical Habitat Units shown in green on the Threatened and Endangered Species map:
 - 4.6 million acres of Federal Lands.
 - 2,456 miles of rivers in the Four Corners Region.
 - This limits clearcutting, mining, and grazing on these lands.
- ✓ Federal hydroelectric dam operators must release water to imitate natural water flows needed by the fish rather than maximize the value of electricity production.
- ✓ Federal agencies are implementing programs to improve habitats.

What is the Goal?

- ✓ To prevent extinction of these 62 species and promote a large enough recovery of their populations so they are no longer Threatened and Endangered.

What are the Costs?

- ✓ A reduction in timber harvest, electricity production, livestock grazing, and mining in the Four Corners Region.
- ✓ Implementing programs to improve habitats costs money.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs to protect these 62 Threatened and Endangered Species are too high and they propose to:

- ✓ *Eliminate:* funding for habitat improvements for the 62 Threatened and Endangered Species in the Four Corners Region.
 - ✓ *Eliminate:* Critical Habitat Units for the 62 species as shown on the Threatened and Endangered Species map.
 - ✓ *Allow:* clearcutting, grazing, and mining in the Critical Habitat Units in Four Corners Region.
- (Note: These proposals are limited to the Four Corners Region shown on the map and would not reduce protection of other Threatened and Endangered Species in the remaining 46 states.)

What Would Happen to Populations of Threatened and Endangered Species in the Four Corners Region if these Changes are Made?

It is very likely that *half* of the 62 Threatened and Endangered Species listed in Figure 1 would become extinct in the next 15 years.

The following chart (Figure 1) shows the 25 different types of Threatened Species and 37 different types of Endangered Species found only in the Four Corners Region and nowhere else in the United States.

Figure 1: Types of Threatened and Endangered Species Found Only in the Four Corners Region

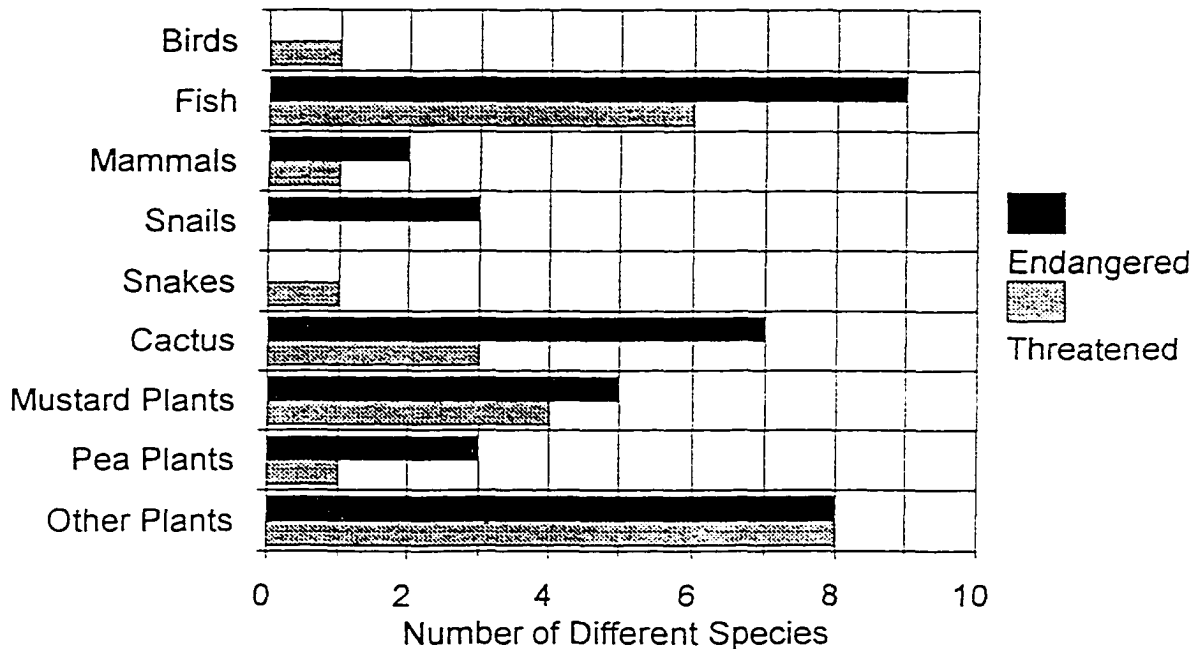


Figure 9
Survey Treatment 3: Types of Threatened and Endangered Species Found Only in the Four Corners Region

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Species Trust Fund** to pay the costs.
- ✓ By law, the funds could *only* be used to improve habitat.

Who Would Pay?

- ✓ Loggers, miners, and others using natural resources from Federal Lands in the Four Corners Region.
- ✓ Visitors to National Forests and Parks in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) most Critical Habitat Units are on Federal land; (b) dams adversely affecting these species are Federally owned and managed; and (c) sufficient revenues are needed for the recovery program for these species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to approve funding the Current Program it would:

- ✓ Maintain Critical Habitat Units shown on the Threatened and Endangered Species map.
- ✓ Fund habitat protection and improvements for all 62 species.
- ✓ Purchase of water rights to maintain instream flows for fish and other species.
- ✓ Save the 37 Endangered Species from extinction and increase the populations of the 25 Threatened Species so that they would no longer be listed as Threatened within 15 years.

If a majority of households in the U.S. vote to not approve the Current Program:

- ✓ The Current Program will be eliminated and Critical Habitat Units shown on the map will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, grazing, and mining will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely that *half* of these 62 species in Figure 1 will become extinct in 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Species Trust Fund was on the ballot in the next nationwide election.

Remember, by law, the funds could *only* be used to improve habitat.

1. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$ 75 every year, would you vote in favor of it?

YES NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted NO on the previous page, please answer the next question. (If you voted YES on the previous page, please go to Section IV on the next page)

We are interested in the main reason you voted NO. Please read all the reasons and then check just the one, most important reason below.

_____ Protecting critical habitat for these species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve these species.

_____ I want the use of resources to continue on these lands and rivers.

_____ I am opposed to paying for government programs.

_____ I do not believe that preserving Endangered and Threatened Species is important.

_____ Other, please explain:

Please continue with the next section

SECTION IV - About You: These last few questions will help us in evaluating the representativeness of our sample. **Your answers are strictly confidential and will only be used for the analysis of this study. You will not be identified in any way.**

1. Are you: Male Female
2. What is your age: Years
3. What is your zip code?
4. How long have you lived within your current state of residence? Years
5. A: Do you live in the Four Corners Region? Yes No
 (Arizona, Southwestern Colorado, Western New Mexico, or Southeastern Utah)
- B: If NO, have you visited the Four Corners Region of the U.S. Yes No
6. Have you visited a National Forest or National Park
 in the Four Corners Region in the past 12 months? Yes No
7. During the past 12 months, have you been:

bird watching?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
fishing?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
hiking or camping?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8. Are you a member of a conservation or environmental organization? Yes No
9. What is your occupation?
10. Did you vote in the last national election? Yes No
11. Highest level of formal schooling? (Please circle one)

1 2 3 4 5 6	7 8 9	10 11 12	13 14 15 16	17 18 19 20 21+
(Elementary)	(Jr. High)	(High School)	(College or Technical School)	(Graduate or Professional School)
12. How many members are in your household? people
13. How many contribute to paying the household expenses? people
14. Including these people, approximately what was your household income from all sources (before taxes)
 last year?

<input type="text"/> less than \$10,000	<input type="text"/> \$40,000 to \$49,999	<input type="text"/> \$80,000 to \$89,999
<input type="text"/> \$10,000 to \$19,999	<input type="text"/> \$50,000 to \$59,999	<input type="text"/> \$90,000 to \$99,999
<input type="text"/> \$20,000 to \$29,999	<input type="text"/> \$60,000 to \$69,999	<input type="text"/> \$100,000 to \$149,999
<input type="text"/> \$30,000 to \$39,999	<input type="text"/> \$70,000 to \$79,999	<input type="text"/> over \$150,000

Thank You for Completing the Survey!

If you have any additional thoughts on endangered species or critical habitat management, please feel free to write them down on the back cover. When you are finished, please put the survey in our **stamped** return envelope and mail it back to us.

APPENDIX 2D
SURVEY TREATMENT 4

**Should Federal Lands
be Used to Provide
Habitat for Endangered Species?**



What do you think?

**Colorado
State**
University

Department of Agricultural and Resource Economics
Fort Collins, Colorado 80523

Management of Endangered Species on Federal Lands in the Four Corners Region

The management of endangered species on Federal Lands is a much debated topic these days. Your views on this topic are an important part of this debate. Before you answer we want to clarify what we mean by Federal Lands and endangered species.

The Federal Endangered Species Act requires protection for Threatened and Endangered Species, including over 65 mammals, 90 birds, 101 fishes, 168 "other species" (such as salamanders, spiders, clams, shrimp, butterflies, turtles, and snails), and 468 plants. Prevention of extinction often requires preserving the habitat necessary for survival.

In this survey we use the following terms:

Endangered Species: are federally listed species that are in danger of extinction within the foreseeable future on a significant portion of their habitat.

Threatened Species: are federally listed species that are likely to become endangered within the foreseeable future on a significant portion of their habitat.

Threatened and Endangered List: is the list of species which are designated by the U.S. Fish and Wildlife Service as Threatened or Endangered.

Critical Habitat Units (CHUs): Land designated by the U.S. Fish and Wildlife Service as crucial for the survival of the species or unoccupied habitat necessary for recovery of the species. Usually some human activity is restricted on these acres. For instance, in forests, timber harvesting and grazing may be restricted.

Federal lands include National Forests, National Parks, lands administered by the Bureau of Land Management and Indian Reservations. These lands total about 136 million acres in the Four Corners Region.

The **Four Corners Region** is Arizona, Southwestern Colorado, Western New Mexico, and Southeastern Utah. This area is known as the "Four Corners" because the borders of these four states meet at this point.

What Benefits Might Threatened and Endangered Species Provide?

While it is difficult to identify the benefit of each individual Threatened and Endangered Species, as a group they provide the following benefits to humans:

1. Indicators of the health of the environment where people live (many species are more sensitive to pollution than humans, so species often serve as an early warning system about rising pollution levels).
2. Potential sources of medicines and substances for industrial and commercial use.
3. Act as stabilizers maintaining a balance among predators and prey so as not to have population explosions of one species or pest.
4. Protecting diversity of species.

Critical Habitat Units for Threatened and Endangered Fish Species in the Four Corners Region

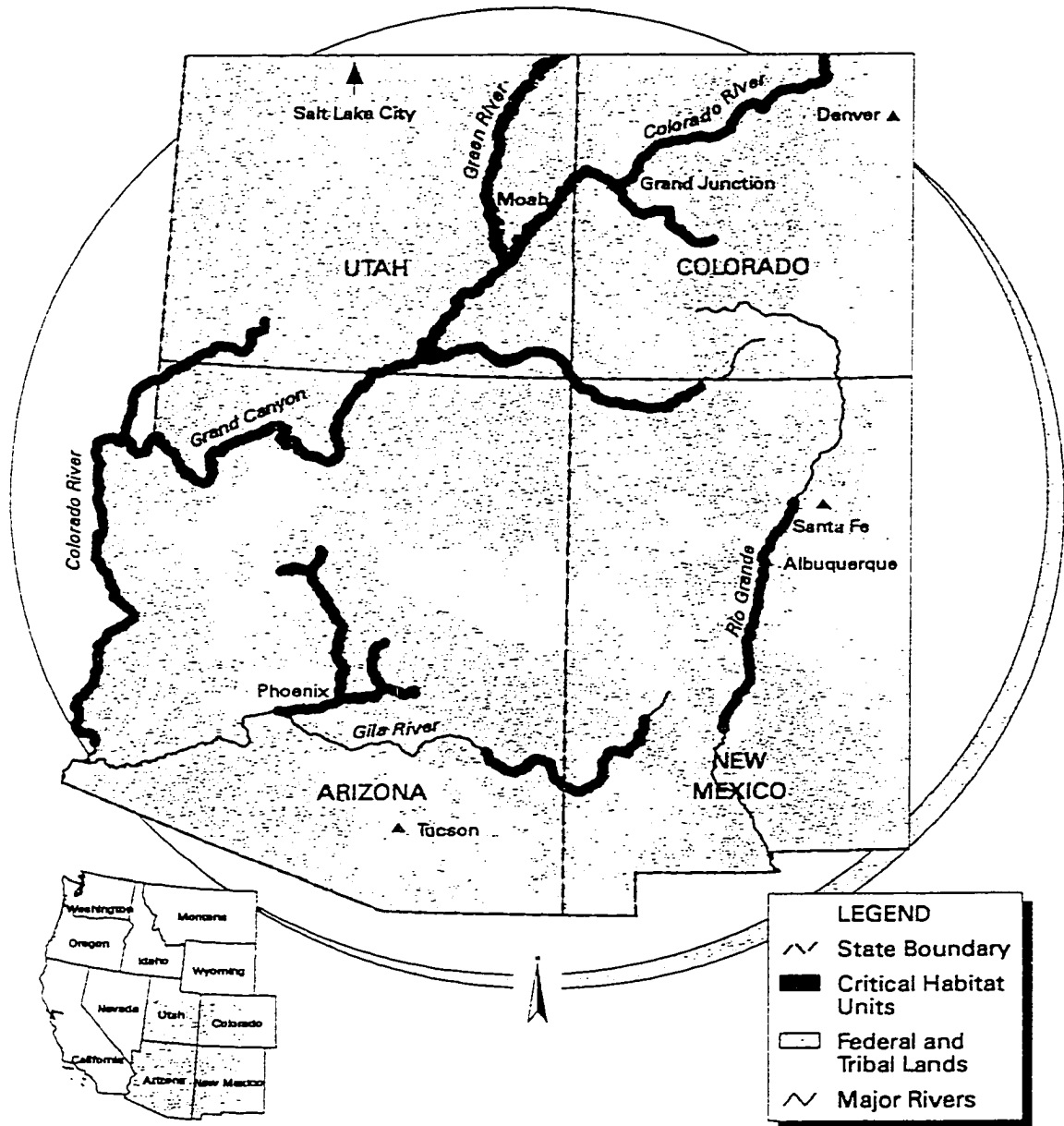


Figure 10
Survey Treatment 4: Critical Habitat Units for Threatened and Endangered Species in
the Four Corners Region

Critical Habitat Units for Threatened and Endangered Species in the Four Corners Region

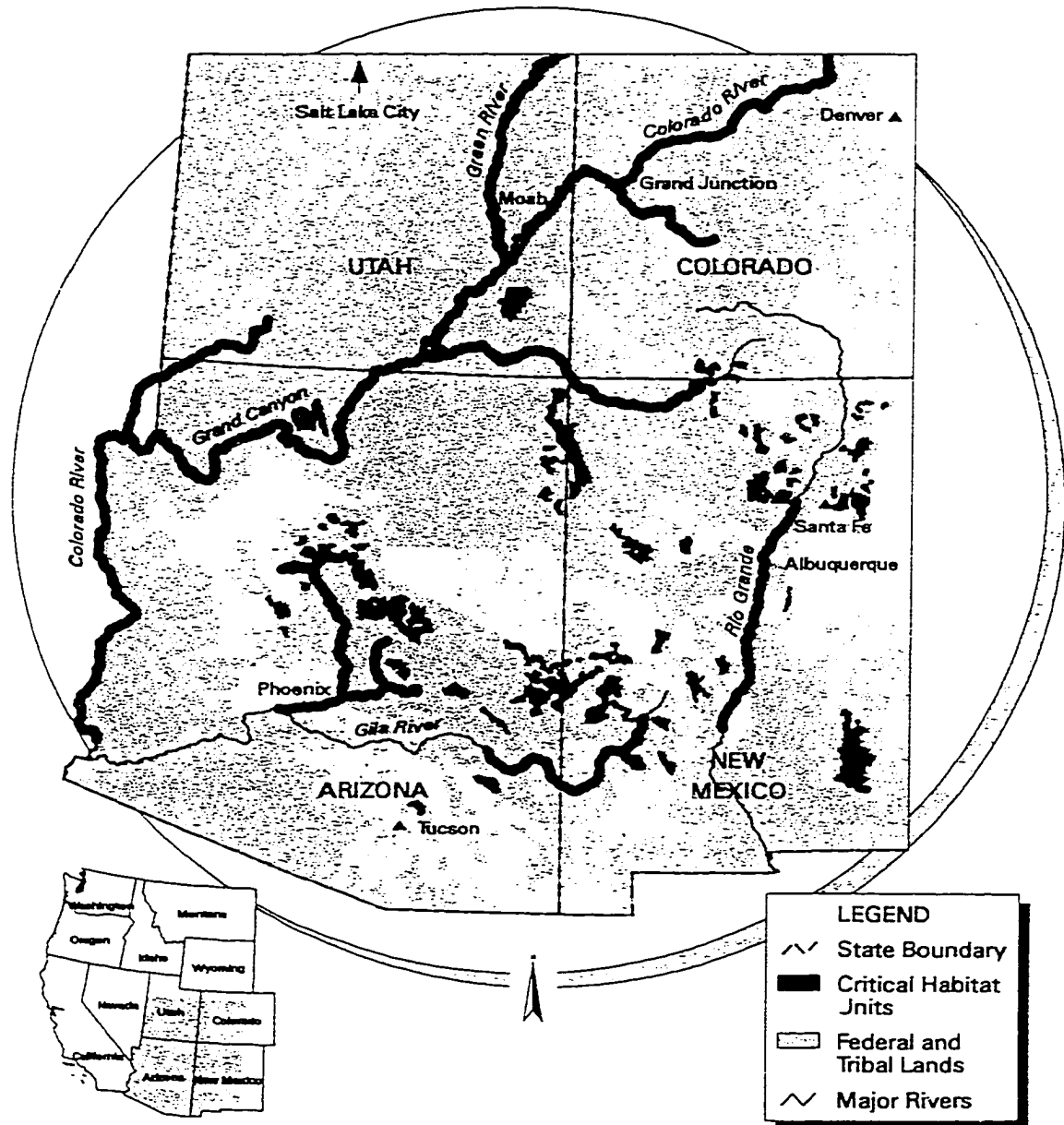


Figure 11
 Survey Treatment 4: Critical Habitat Units for Threatened and Endangered Fish Species in the Four Corners Region

SECTION I - Threatened and Endangered Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

62 Threatened and Endangered Species found only in the Four Corners Region are at risk of extinction. These include fish, birds, mammals, and plants. These are shown in Figure 1 on the next page.

Why are these Species Threatened and Endangered?

Populations of these 62 Threatened and Endangered Species are declining due to a loss of habitat from clearcutting, livestock grazing, mining, damming, and water diversions from rivers. Also, populations are affected by the introduction of non-native species to the habitat.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ Designation of Critical Habitat Units shown in green on the Threatened and Endangered Species map:
 - 4.6 million acres of Federal Lands.
 - 2,456 miles of rivers in the Four Corners Region.
 - This limits clearcutting, mining, and grazing on these lands.
- ✓ Federal hydroelectric dam operators must release water to imitate natural water flows needed by the fish rather than maximize the value of electricity production.
- ✓ Federal agencies are implementing programs to improve habitats.

What is the Goal?

- ✓ To prevent extinction of these 62 species and promote a large enough recovery of their populations so they are no longer Threatened and Endangered.

What are the Costs?

- ✓ A reduction in timber harvest, electricity production, livestock grazing, and mining in the Four Corners Region.
- ✓ Implementing programs to improve habitats costs money.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs to protect these 62 Threatened and Endangered Species are too high and they propose to:

- ✓ *Eliminate:* funding for habitat improvements for the 62 Threatened and Endangered Species in the Four Corners Region.
- ✓ *Eliminate:* Critical Habitat Units for the 62 species as shown on the Threatened and Endangered Species map.
- ✓ *Allow:* clearcutting, grazing, and mining in the Critical Habitat Units in Four Corners Region.

(Note: These proposals are limited to the Four Corners Region shown on the map and would not reduce protection of other Threatened and Endangered Species in the remaining 46 states.)

What Would Happen to Populations of Threatened and Endangered Species in the Four Corners Region if these Changes are Made?

It is very likely that *half* of the 62 Threatened and Endangered Species listed in Figure 1 would become extinct in the next 15 years.

The following chart (Figure 1) shows the 25 different types of Threatened Species and 37 different types of Endangered Species found only in the Four Corners Region and nowhere else in the United States.

Figure 1: Types of Threatened and Endangered Species Found Only in the Four Corners Region

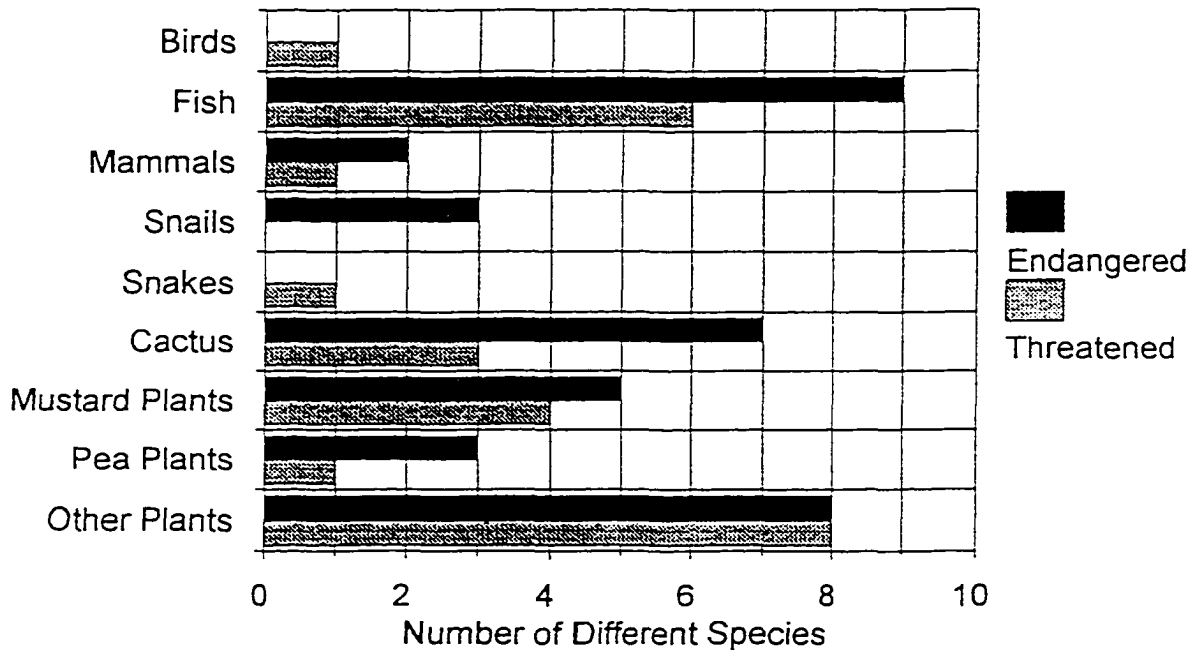


Figure 12
Survey Treatment 4: Types of Threatened and Endangered Species Found Only in the Four Corners Region

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Species Trust Fund** to pay the costs.
- ✓ By law, the funds could *only* be used to improve habitat.

Who Would Pay?

- ✓ Loggers, miners, and others using natural resources from Federal Lands in the Four Corners Region.
- ✓ Visitors to National Forests and Parks in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) most Critical Habitat Units are on Federal land; (b) dams adversely affecting these species are Federally owned and managed; and (c) sufficient revenues are needed for the recovery program for these species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to approve funding the Current Program it would:

- ✓ Maintain Critical Habitat Units shown on the Threatened and Endangered Species map.
- ✓ Fund habitat protection and improvements for all 62 species.
- ✓ Purchase of water rights to maintain instream flows for fish and other species.
- ✓ Save the 37 Endangered Species from extinction and increase the populations of the 25 Threatened Species so that they would no longer be listed as Threatened within 15 years.

If a majority of households in the U.S. vote to not approve the Current Program:

- ✓ The Current Program will be eliminated and Critical Habitat Units shown on the map will no longer be protected.
- ✓ No habitat improvements will occur.
- ✓ Clearcutting, grazing, and mining will be allowed on these Critical Habitat Units.
- ✓ Biologists estimate that it is very likely that *half* of these 62 species in Figure 1 will become extinct in 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Species Trust Fund was on the ballot in the next nationwide election.

Remember, by law, the funds could *only* be used to improve habitat.

1. If the Four Corners Region Threatened and Endangered Species Trust Fund was the only issue on the next ballot and it would cost your household \$ 50 every year, would you vote in favor of it?

YES

NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted **NO** on the previous page, please answer the next question. (If you voted **YES** on the previous page, please go to Section II on the next page)

We are interested in the main reason you voted **NO**. Please read all the reasons and then check just the one, most important reason below.

_____ Protecting critical habitat for these species is not worth this much money to me.

_____ I cannot afford to pay this amount.

_____ It is unfair to expect me to pay for the protection of critical habitat.

_____ Protecting critical habitat will not help preserve these species.

_____ I want the use of resources to continue on these lands and rivers.

_____ I am opposed to paying for government programs.

_____ I do not believe that preserving Endangered and Threatened Species is important.

_____ Other, please explain:

Please continue with the next section

SECTION II - Your Views on Endangered Species Management

People often have different views about environmental and economic issues. Please indicate your view by **CIRCLING ONE NUMBER FOR EACH STATEMENT.**

Note that a 1=strongly agree and 5= strongly disagree.

	<u>STRONGLY AGREE</u>		<u>NEUTRAL</u>		<u>STRONGLY DISAGREE</u>
Businesses should be allowed to extract natural resources from Federal lands.	1	2	3	4	5
All species endangered due to human activities should be protected from extinction whether or not they appear important to human well being.	1	2	3	4	5
Plants and animals have as much right as humans to exist. ...	1	2	3	4	5
I am glad that the endangered species in the Four Corners Region are protected even if I never see them.	1	2	3	4	5
If any jobs are lost, the cost of protecting a Threatened or Endangered Species is too large.	1	2	3	4	5
Protection of Threatened and Endangered Species is a responsibility I am willing to pay for.	1	2	3	4	5

Have you read or heard about threats to the Northern Spotted Owl in the Northwestern United States?

Yes No

Have you read or heard about threats to the Mexican Spotted Owl in the Southwestern United States?

Yes No

Have you read or heard about threatened and endangered fish in the Colorado River?

Yes No

SECTION III - Threatened and Endangered Fish Species in the Four Corners Region

Before answering the next few questions, it is important to read the following:

WHAT IS THE PROBLEM?

The enclosed Threatened and Endangered Fish Map highlights in green the sections of major rivers that are or are being proposed as Critical Habitat Units for nine Threatened or Endangered fish species that live in the following rivers:

<u>Colorado River</u>	<u>San Juan and Green Rivers</u>	<u>Virgin River, UT</u>	<u>Gila River, AZ, NM</u>	<u>Rio Grande, NM</u>
Bonytail Chub	Colorado Squawfish	Virgin River Chub	Loach Minnow	Silvery Minnow
Colorado Squawfish	Razorback Sucker	Woundfin	Spikedace	
Humpback Chub				
Razorback Sucker				

Why are these Fish Threatened or Endangered?

- ✓ Diversion of streams for irrigation reduces fish habitat.
- ✓ Hydroelectric and other dams change the temperature and natural flow of the rivers as well as block the natural movement of the fish.
- ✓ Introduction of non-native species.

CURRENT PROGRAM

What is Currently Being Done to Prevent Extinction?

- ✓ 2,456 miles of river shown in green on the Threatened and Endangered Fish map are designated Critical Habitat Units.
- ✓ Federal hydroelectric and other dam operators must release water from the dams at critical locations to imitate natural water flows needed by the fish rather than maximize electricity production.
- ✓ Fish habitat is being improved and fish passageways are being constructed around diversion dams.

What is the Goal?

Prevent extinction and increase populations to the point they are no longer threatened or endangered.

What are the Costs?

- ✓ Reduced hydropower revenue to the Federal government.
- ✓ Construction costs for the fish passageways.

THREATS TO THE CURRENT PROGRAM

Some State and Federal officials believe the costs of protecting these Nine Threatened and Endangered fish species are too high and propose to:

- ✓ *Eliminate:* Critical Habitat Unit protection on the 2,456 miles of river.
- ✓ *Allow:* Federal dam operators to time water releases to maximize hydropower.
(Note, these proposals are limited to the rivers in the Four Corners Region shown on the map and would not reduce protection of Threatened and Endangered species in the other 46 states).

What Would Happen to the Nine Threatened and Endangered Fish Species if These Changes are Made?

It is very likely that *four* of the nine fish species listed above would become extinct in the next 15 years.

PROPOSAL TO FUND THE CURRENT PROGRAM

- ✓ Establish a **Four Corners Region Threatened and Endangered Fish Trust Fund** to pay these costs.
- ✓ Funds would protect and improve habitat for fish.

Who Would Pay?

- ✓ Irrigators diverting water from rivers in the Four Corners Region.
- ✓ River and reservoir recreation users through entrance and camping fees in the Four Corners Region.
- ✓ U.S. taxpayers need to contribute because: (a) the dams adversely affecting the nine fish are Federally owned and managed; (b) most Critical Habitat Units are on Federal lands; (c) sufficient revenues are needed for the recovery program for the nine fish species.

YOUR CHANCE TO VOTE

If a majority of households in the U.S. vote to approve funding the Current Program it would:

- ✓ Maintain Critical Habitat Units for the nine Threatened and Endangered fish species to avoid extinction.
- ✓ Provide water releases from Federal dams timed to benefit fish.
- ✓ Purchase water rights to maintain instream flows on the rivers shown in green on the Threatened and Endangered Fish map.
- ✓ Within the next 15 years, three fish species would increase in population to the point they would no longer be listed as Threatened species.

If a majority of households in the U.S. vote to not approve the Current Program:

- ✓ The Critical Habitat Units shown on the Threatened and Endangered Fish map would be eliminated.
- ✓ No habitat improvements would occur.
- ✓ Water diversion activities and maximum power production would occur, reducing the amount of habitat for these nine fish species.
- ✓ Biologists estimate that it is very likely that *four* of the nine fish species will become extinct in the next 15 years.

Suppose a proposal to establish a Four Corners Region Threatened and Endangered Fish Trust Fund was on the ballot in the next nationwide election. How would you vote on this proposal?

Remember, by law, funds could *only* be used to protect and improve habitat for fish.

1. If the Four Corners Region Threatened and Endangered Fish Trust Fund was the only issue on the next ballot and it would cost your household \$ 50 every year, would you vote in favor of it?

YES

NO

2. On a scale of 1 to 10, how certain are you of your answer to the previous question? Please circle the number that best represents your answer if 1=not certain and 10= very certain.

1 2 3 4 5 6 7 8 9 10
not certain <-----> very certain

3. Instructions: If you voted NO on the previous page, please answer the next question. (If you voted YES on the previous page, please go to Section IV on the next page)

We are interested in the main reason you voted NO. Please read all the reasons and then check just the one, most important reason below.

- Protecting critical habitat for these species is not worth this much money to me.
 I cannot afford to pay this amount.
 It is unfair to expect me to pay for the protection of critical habitat.
 Protecting critical habitat will not help preserve these species.
 I want the use of resources to continue on these rivers.
 I am opposed to paying for this government program.
 I do not believe that preserving endangered or threatened species is important.
 Other, please explain:

Please continue with the next section

Thank You for Completing the Survey!

If you have any additional thoughts on endangered species or critical habitat management, please feel free to write them down on the back cover. When you are finished, please put the survey in our **stamped** return envelope and mail it back to us.