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Economic Tradeoffs in Preserving Riparian Habitat

Bonnie Colby

Patricia Orr

BONNIE COLBY & PATRICIA ORR*

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ABSTRACT

Riparian habitat has been diminishing throughout the Western United States due to land development and water diversions. Efforts to preserve remaining riparian habitat confront problems with competition for water and inadequate policy mechanisms to assure water for habitat maintenance. This article highlights economic tradeoffs in efforts to preserve the San Pedro River in southeastern Arizona and reports the results of a recent contingent valuation method study determining visitors' willingness to pay for riparian area preservation.

I. INTRODUCTION

The Upper San Pedro River Basin in southeastern Arizona provides a prime example of a difficult policy process involving riparian area preservation. The effects of surface water diversions and groundwater depletion threaten the ecological integrity of the Basin's riparian areas, including the congressionally designated San Pedro Riparian National Conversation Area (SPRNCA).[1] Difficult policy choices will have to be made in order to preserve remaining riparian habitat given growing municipalities and existing agricultural water uses. The complex relationship between the natural, political, economic, and legal systems poses a challenge to policy makers attempting to resolve this issue. Gaining local support for water policies to aid preservation and funding for preservation efforts is especially daunting to policy makers. To aid in the formulation of effective policy, there must be some information on the willingness to pay for such an initiative on the part of park visitors. This article reports the results of a contingent

1. ROBERT GLENNON, WATER FOLLIES: GROUNDWATER PUMPING AND THE FATE OF AMERICA'S FRESH WATERS 53-54 (2002).

valuation study of the SPRNCA (Figure 1). Of course, economic values associated with habitat preservation are only one part of the overall costs and benefits to be considered in this difficult, ongoing water management conflict.
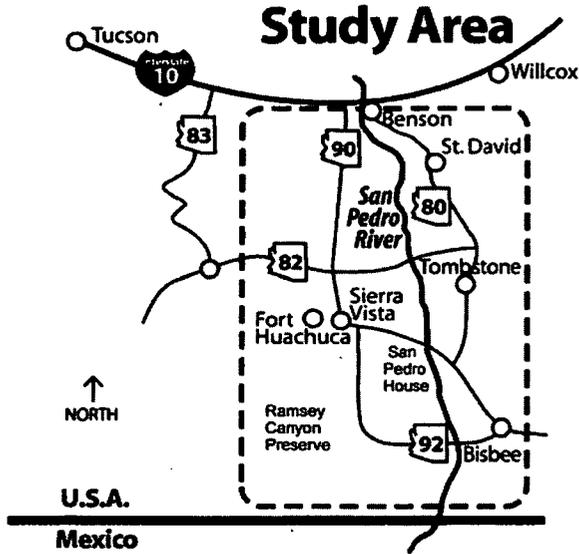
A. The San Pedro River Basin

A primary draw for visitors to the San Pedro River Basin is its high native bird biodiversity, one of the highest in the United States. The riparian corridor plays a vital role in maintaining national and transnational species diversity.[2] Between one and four million migrating songbirds use the riparian habitat annually, including rare and endangered species such as the Yellow-Billed Cuckoo and the Southwestern Willow Flycatcher.[3]

The bird diversity in the Basin is primarily due to riparian habitat. The San Pedro River is an oasis between the Sonoran and Chihuahuan deserts and the Plains grasslands, and it provides the most

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2. *Id.* at 53; Fredrick Steiner et al., *A Watershed at a Watershed: The Potential for Environmentally Sensitive Area Protection in the Upper San Pedro Drainage Basin (Mexico and USA)*, 49 LANDSCAPE & URB. PLAN. 129, 130, 137 (2000).

3. SAN PEDRO EXPERT STUDY TEAM FOR THE COMMISSION ON ENVIRONMENTAL COOPERATION, SUSTAINING AND ENHANCING RIPARIAN MIGRATORY BIRD HABITATATION [SIC] ON THE UPPER SAN PEDRO RIVER, UPPER SAN PEDRO RIVER TECHNICAL REPORT 89 (1999).

important source of ephemeral and perennial surface water in the region. The unusual degree of biodiversity results from the location of the San Pedro at a juxtaposition of three ecosystems.[4] However, the area's water resources not only define the rich ecological composition of the area, but also serve municipal and agricultural needs. Municipal and agricultural water consumption has altered the hydrologic balance in the Basin and threatens the riparian habitat. Urban expansion in the Basin is significant, particularly in Sierra Vista.

The contingent valuation study focused on willingness-to-pay (WTP) for preservation of the SPRNCA riparian habitat. The area was initially acquired by the Bureau of Land Management (BLM) in 1986. Congressionally designated in 1988, SPRNCA spans 36 miles of river corridor and covers almost 57,000 acres.[5]

The SPRNCA was established to protect floristic, aquatic, wildlife, archaeological, paleontological, scientific, cultural, educational, and recreational resources of the public land surrounding the San Pedro River.[6] It serves as a migratory passage for national and trans-national birds, in addition to supporting a wide diversity of other wildlife. In 1996, the area was designated a "Globally Important Bird Area" by the American Bird Conservancy and the BLM. This was the first designation of its kind in the United States.[7] The Nature Conservancy has highlighted the area as one of the "Last Great Places"[8] and American Rivers has designated it as one of the most threatened rivers in the United States.[9]

II. ARIZONA WATER LAW AND POLICY

Groundwater pumping by rapidly urbanizing areas and agricultural water use threaten the ecological integrity of the riparian areas of the Upper San Pedro River Basin and the SPRNCA. When Congress set aside the SPRNCA for the public, it set aside by implication a federal water right of sufficient quantity to satisfy the primary purpose

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4. Steiner et al., *supra* note 2, at 137.

5. Arizona Idaho Conservation Act, Pub. L. No. 100-696, tit. I, sec. 101(b), 102 Stat. 4571 (1988) (codified at 16 U.S.C. § 460xx (2000)).

6. *Id.*

7. DAWN MCKNIGHT & COLIN DEIHL, EARTHLAW, A SUBMISSION PURSUANT TO ARTICLE 13 OF THE NORTH AMERICAN AGREEMENT ON ENVIRONMENTAL COOPERATION 2 (1996), *available at* http://www.cec.org/files/pdf/sem/ACF158.pdf (last visited Mar. 6, 2005); *see also* GLENNON, *supra* note 1, at 53.

8. THE NATURE CONSERVANCY ET AL., MIRACLE IN THE DESERT: EXPLORE THE LAST GREAT PLACES AND TOUR OF THE SAN PEDRO, *at* http://www.lastgreatplaces.org/SanPedro (last visited Mar. 6, 2005); *see also* GLENNON, *supra* note 1, at 53.

9. GLENNON, *supra* note 1, at 53.

of maintaining the SPRNCA.[10] Water users in the area who initiated their water right before the creation of the SPRNCA are permitted to continue their customary water use. However, in principle, federal law protects the SPRNCA from interference by subsequent water users.[11] These federal reserved water rights are "only theoretical at this point in time," pending completion of the water rights adjudication for the Gila River Basin.[12]

Water rights associated with the entire San Pedro River (a tributary of the Gila River) will be directly impacted by the ongoing Gila River Adjudication. This large-scale, complex litigation is seeking to determine the relative rights (including ground-surface water interconnectedness) on the stream system. This litigation commenced in 1975 but may take another decade or more to resolve. In the interim, the future of the riparian habitat as influenced by water use and water rights is uncertain.

Water use on the San Pedro will potentially be impacted by litigation associated with the Endangered Species Act (ESA). The ESA requires the identification and designation of "critical habitat" in order to provide for the species' survival and recovery.[13] The Center for Biological Diversity and other groups have brought lawsuits that resulted in the designation of critical habitat for two threatened fish, the loach minnow and the spikedace.[14] In Arizona, this designated critical habitat includes the San Pedro River. However, these practical ramifications of the ESA for water management in the San Pedro Basin are not at all clear. To date, no water uses have been circumscribed as a result of ESA litigation or critical habitat designation.

The 1980 Arizona Groundwater Management Act governs the allocation and use of ground water.[15] The Act created four Active Management Areas (AMA) with specific regulations on groundwater pumping, and two Irrigation Non-Expansion Areas (INA) in which expansion of irrigated agriculture is prohibited.[16] The San Pedro River

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    10.   Arizona-Idaho Conservation Act, Pub. L. No. 100-696, tit. I, § 102(d), 102 Stat. 4571 (1988) (codified at 16 U.S.C. § 460xx (2000)).
    11.   GLENNON, *supra* note 1, at 62.
    12.   *Id.*
    13.   Joe Gelt, *Saving Endangered Species Poses Water Policy Challenge*, ARROYO, Oct. 1996, *available at* http://ag.arizona.edu/AZWATER/arroyo/093save.html (last visited Mar. 6, 2005).
    14.   GLENNON, *supra* note 1, at 64.
    15.   ARIZ. REV. STAT. §§ 45-401 to 45-704 (2003 & Supp. 2004-2005).
    16.   Laurel J. Lacher, Hydrologic and Legal Issues of the Upper San Pedro River Basin, Arizona (Dec. 3, 1994) (unpublished manuscript, on file with Semi-Arid Land Surface Atmosphere Program), *available at* http://www.tucson.ars.ag.gov/salsa/archive/publica tions/lacher/lacher0.html (last visited Mar. 5, 2005).

Basin was not among those originally designated as either an AMA or an INA. The director of the Arizona Department of Water Resources (ADWR) has the power to designate additional AMAs and INAs but has not exercised that power to establish regulations governing groundwater use in the San Pedro Basin. The power has been exercised however, as a new AMA has been established elsewhere in Arizona. An AMA designation would require basin-wide regulation to provide an assured water supply in the future, control safe yield, and establish conservation goals.

INA status would be valuable to the preservation of the San Pedro River Basin by limiting new groundwater pumping for irrigation purposes in designated basins. Without INA status, there is no mechanism to control groundwater use for irrigation. As a result, attempts to reduce agricultural use in one part of the Basin do not preclude increased irrigation use in other areas. This was illustrated in the mid-1990s, when The Nature Conservancy purchased and retired 500 acres of irrigated land to limit depletion of stream flows along the San Pedro. The intended impact of this purchase was counteracted when the landowner who sold the agricultural land subsequently commenced irrigation on another 500-acre parcel a short distance away.[17] Currently, irrigated crops are grown on less than five percent of the land area of the entire San Pedro River Basin. However, inactive (but previously irrigated) farmland can be brought back into production and new land can be cultivated for crop production.[18] An INA designation would provide an important mechanism to formalize the water rights associated with the existing irrigated agricultural land in the Upper San Pedro River Basin and preclude additional acres from being brought into irrigated production.

Beyond the rapid growth of Sierra Vista and the decline of traditional agricultural production, other changes are redefining the nature of the Upper San Pedro River Basin. The purchasing and parceling of land into "hobby farms" and "ranchettes" by people looking for open space and a more rural lifestyle is changing the nature of the basin.[19] Other changes include the growth of smaller cities, which are promoted as ideal locations for retirement, tourism, and bedroom communities for many living and working in Sierra Vista and Tucson.

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17. SAN PEDRO EXPERT STUDY TEAM FOR THE COMMISSION ON ENVIRONMENTAL COOPERATION, *supra* note 3, at 58; GLENNON, *supra* note 1, at 66.
    18. GLENNON, *supra* note 1, at 66–67.
    19. CLIMAS, AN ASSESSMENT OF CLIMATE VULNERABILITY IN THE MIDDLE SAN PEDRO RIVER, CLIMAS REPORT SERIES, DRAFT: CL3-00, U. ARIZ. INST. FOR STUDY OF PLANET EARTH 27 (Timothy J. Finan ed., 2000), *available at* http://www.ispe.arizona.edu/climas/pubs/CL3-00.html (last visited Mar. 6, 2005).

These changes are redefining water use patterns, further complicating and challenging efforts to manage the water resources of the Basin.

There have been several efforts to solve the water problems of the Basin through cooperation and collaboration. The most recent collaborative effort to achieve consensus is the Upper San Pedro River Partnership. The partnership is made up of federal, state, county, and city agencies and The Nature Conservancy. Each of these organizations owns land, makes land and water use policy, or has resource expertise in the Upper San Pedro River Basin. Prior to the creation of the partnership, several attempts at achieving consensus were unsuccessful, including the Water Issues Group, the County Comprehensive Plan, and a brief, federally sponsored water rights negotiation. However, many parties remain committed to "community collaboration and cooperation" strategies to save the San Pedro River.[20] In the meantime, and until adequate water is reserved for ecosystem needs, the ecological integrity of the Upper San Pedro River Basin remains in peril.

As various courses of action are considered to save the riverine habitat, the question of the value placed on the preservation remains. This article examines willingness to pay by visitors, an important population to consider because of the economic inflows they bring to this region.

III. CONTINGENT VALUATION METHODOLOGY

A contingent valuation study was undertaken with the cooperation of The Arizona Nature Conservancy and the BLM in 2001. The survey of Upper San Pedro riparian area visitors spanned five months (spring and late summer bird migration seasons) during which 843 surveys were collected. Of these, 551 contained complete and valid data for econometric estimation. The survey target population was visitors living outside the Upper San Pedro River Basin. The questionnaire was administered at the Basin's two commonly visited birding sites, one in SPRNCA and one at the Ramsey Canyon Preserve owned by The Nature Conservancy.

Site visitors were randomly selected to participate, with only one respondent per household or small group. Each respondent was presented with a brief introduction describing the purpose of the study and the nature and length of the questionnaire. Eighty-four percent of eligible visitors contacted participated in the study. The surveys were completed on-site at shaded tables set up for this purpose. The survey

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20.   GLENNON, *supra* note 1, at 62–63.

was pre-tested in February 2001, with site visitors similar to those who participated in the final sample.

A. Survey Instrument Design

The survey was divided into four parts: visitation patterns, expenditures, willingness to pay (WTP), and socio-economic and demographic characteristics of the visitors. The WTP section presented a hypothetical scenario, followed by a WTP payment card, photographs of healthy and degraded riparian landscapes, and questions on the visitor's anticipated change in visitation.

B. The Constructed Market

The contingent valuation method provides respondents with a context within which they can assess the value of a good or service that is traditionally outside consumer markets. In this study, the "constructed market" was presented to the participants with a hypothetical scenario that described the purpose of the proposed riparian area preservation initiative, the baseline level of riparian ecosystem health and the effects of the preservation initiative, the payment vehicle, and a value elicitation question asking the participant how much they would be willing to contribute to the riparian area preservation initiative. Respondents were presented with the following "scenario":

> Congress created the 56,000-acre San Pedro Riparian National Conservation Area (RNCA) in order to protect and enhance this desert riparian ecosystem. The diversity of birds and other wildlife found in the San Pedro RNCA is largely due to lush riparian forest along the river's bank, which depends on adequate water (Photograph 1). To remain healthy, this riparian area requires the continual movement of ground water from the underground aquifer of the San Pedro River valley into the riparian area. It is this underground water that keeps the river flowing, even during long dry periods.
>
> Suppose that these water flows are threatened and a non-profit foundation has been formed to acquire water and to promote regional water conservation in order to maintain the San Pedro RNCA as it is today. If the foundation does not receive enough contributions from individuals like you, adequate water flows will not be available. Trees and other plants would begin to die, degrading the riparian habitat

and reducing the abundance and diversity of birds and other wildlife (Photograph 2).

Respondents could choose among thirteen bid categories (from zero to $1000) in a payment card-type format. The bid categories were determined based on pretesting and on a 1991 CVM study of visitors to SPRNCA.[21] The payment card amount selected is not an exact statement of WTP, but an indication that actual WTP lies in the interval between the chosen amount and the next highest option.[22] This study followed the standard practice of using the interval midpoint to represent respondent's WTP.

Follow-up questions were included to determine reasons for positive or zero bids. Positive bidders were queried on where they would obtain the money for their hypothetical bid. "Zero" bidders were questioned in order to distinguish valid zero WTP bids from "protest" zero bids. A protest bid occurs when the respondent objects to the hypothetical market, while a valid zero bid represents a respondent who accepts the constructed market but is not willing to pay for preservation.

Photographs of healthy and degraded riparian habitat were included in the survey. The first photograph depicted a reach of the San Pedro River where the water table has remained high enough to maintain a healthy riparian habitat. The second photograph represented a stream reach where water table decline has resulted in a degraded riparian area. For purposes of illustration, this photograph was of a reach of the Santa Cruz River and was labeled as such. Both rivers are located in southeastern Arizona, approximately 50 miles apart, the former representing a healthy-but-threatened riparian area, and the latter a riverine ecosystem degraded due to inadequate stream flows. While the scenario presented to the respondents for the San Pedro River was hypothetical, the degradation represented by the photograph of the Santa Cruz River, in close proximity to the San Pedro River, is a reality. The dewatering of the Santa Cruz River was caused by the same type of competition for water and aquifer drawdown that now threatens the San Pedro.

Finally, respondents indicated changes in their future visitation patterns to the SPRNCA in response to the hypothetical scenario of riparian habitat degradation.

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21. Stephanie Kirchoff, Estimating the Benefits of Instream Flows—Case Studies from Arizona and New Mexico 258–62 (1994) (unpublished M.S. thesis, University of Arizona). This study examined visitors' values for riparian habitat in several regions of the southwest, including the Upper San Pedro River.

22. Anni Huhtala, *What Price Recreation in Finland? – A Contingent Valuation Study of Non-Market Benefits of Public Outdoor Recreation,* 36 J. LEISURE RES. 23, 31 (2004).

C. Statistical Estimation Methods and Analysis

In a WTP survey, not all surveys are useable. Reasons for non-usability include (a) non-response to essential questions, (b) protest bids, (c) inconsistencies among income-related variables, and (d) WTP reported at greater than five percent of income. Zero bids were categorized as either protests or genuine zeros, depending on the motive given by the respondent. A total of 45 protest zero bids accounted for 31 percent of all zero bids and six percent of all zero and non-zero bids. The majority of respondents found the hypothetical market to be realistic and indicated a positive WTP for riparian area preservation. Due to some incomplete surveys, the final usable sample size was 551 for the WTP model. This is not uncommon for contingent valuation surveys where non-response rates of 20 to 30 percent for the WTP elicitation questions alone are commonly encountered.[23]

If the respondent gave a positive bid, they had the opportunity to respond to a follow-up question evaluating why they gave a positive bid (Table 1).

Table 1: Reasons for a Positive WTP Bid

Reason why the subset of people would pay	Total Surveys	
	No. of resp	%
I am a regular visitor to the SPRNCA.	35	5.6
I plan to become a regular visitor to the SPRNCA.	14	2.2
I want this riparian area to be maintained so that others can enjoy it.	211	33.6
I receive satisfaction from knowing that this riparian habitat will be maintained.	290	46.3
Other reason.	35	5.9
No reason given.	42	6.7
Total	627	100

Respondents were next asked where they would obtain the funds necessary to pay their bid. The respondents chose from specific categories of spending from which they would deduct their preservation contribution (Table 2).

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23.   ROBERT CAMERON MITCHELL & RICHARD T. CARSON, USING SURVEYS TO VALUE PUBLIC GOODS: THE CONTINGENT VALUATION METHOD 267 (1989).

Table 2: Categories of Reduced Spending to Finance the WTP Bids

	Total Surveys	
Categories of reduced spending	N	%
1. Groceries	18	2.9
2. Entertainment	140	22.3
3. Savings	55	8.8
4. Contribution to environmental causes	113	18.0
5. Vacation	119	19.0
6. Charitable contributions	22	3.5
7. Other	89	14.2
8. No answer	71	11.3
Positive WTP	627	100%

D. Econometric Methods

A WTP dependent variable can be analyzed using several econometric models. Ordinary least squares models often prove to be inappropriate for contingent valuation studies where the data (1) are censored at the lower end (zero) and higher end ($1000) and (2) the WTP are intervals rather than continuous data.[24] The Tobit model[25] is a nonparametric method often used when variables do not meet parametric assumptions.[26] The Tobit model is a censored regression model, appropriate when the dependent variable is censored. Censoring occurs where the dependent variable, but not the independent variables, is observed within a restricted range so that all observations on the dependent variable that are below or above a threshold level are treated as if they were on the threshold.[27]

In this study, the form of Tobit model employed was a two-limit censored regression model.[28] Johnston and DiNardo suggest a formal test to determine if a Tobit model is the correct choice.[29] The test involves a comparison of ratio likelihood estimates of the betas divided by the

24. WILLIAM H. GREENE, ECONOMETRIC ANALYSIS 912–14 (4th ed. 1997).
25. James Tobin, *Estimation of Relationships for Limited Dependent Variables*, 26 ECONOMETRICA 24, 24–36 (1958).
26. John M. Halstead et al., *Use of the Tobit Model in Contingent Valuation: Experimental Evidence from the Pemigewasset Wilderness Area*, 33 J. ENVTL. MGMT. 79, 81 (1991).
27. RICHARD BREEN, REGRESSION MODELS: CENSORED, SAMPLE SELECTED OR TRUNCATED DATA, QUANTITATIVE APPLICATIONS IN THE SOCIAL SCIENCES SERIES, NO. 111, at 2–4 (1996).
28. G.S. MADDALA, LIMITED-DEPENDENT AND QUALITATIVE VARIABLES IN ECONO-METRICS 160–62 (1983); R.N. Rosett & F.D. Nelson, *Estimation of the Two-Limit Probit Regression Model*, 43 ECONOMETRICA 141, 141–46 (1975).
29. JACK JOHNSTON & JOHN DiNARDO, ECONOMETRIC METHODS 439–40 (4th ed. 1997).

estimated standard errors across a Probit and a Tobit model. The results should be comparable when treating all positive bids as one in the Probit model. In this study, the results were similar, suggesting the Tobit model is not mis-specified. The variables specified in the model were guided by economic theory (Table 3). Several variables were included in logarithmic form. A respondent is classified as a repeat visitor if he or she visited the study area previously.

Table 3: Definitions of Variables and Expected Signs

Variable	Description	Type	Sign
wtp_actual	Actual stated willingness to pay (WTP) — the dependent variable in this payment card WTP contingent valuation model	Discrete	
wtp_interval	Assigned interval of willingness to pay (WTP) — the dependent variable in this payment card WTP contingent valuation model	Discrete	
Purpose_trip	Purpose of trip to the study area (1=birding was the main purpose, 0 otherwise)	Dummy	+
ln_days_birding	The natural log of the number of days spent birding per year	Continuous	+
Change_visits	Change in visitation if the riparian area is degraded	Discrete	-
ln_income_mid	Natural logarithm of income	Continuous	+
exp_pp_pd	Expenditure per person per day	Continuous	+
Gender	Respondent's sex (1=female, 0 otherwise)	Dummy	+/-
ln_age	Natural log of the age of the respondents	Continuous	+/-
Employ_full	Employment status (1= full-time, 0 otherwise)	Dummy	+
Retired	Employment status (1=retired, 0 otherwise)	Dummy	+
Education	Level of education (1=Graduate education, 0 otherwise)	Dummy	+
Member	Membership in a conservation/environmental organization (1=yes, 0 otherwise)	Dummy	+
repeat_visitors	Repeat visitors (1 = yes, 0 otherwise)	Dummy	+

A likelihood ratio test was used to evaluate the appropriateness of the heteroskedastic Tobit regression and indicated that Tobit

coefficients from the analysis that included heteroskedasticity provide the correct specification.[30]

The Tobit coefficients that are typically produced by Tobit estimation routines in most software packages relate directly to the unobserved latent variable, WTP*. The WTP* is a (partially) latent variable that is observable only for values above or below the threshold. The reported coefficients show the effect of a change in a given independent variable on the expected value of the latent variable, holding all other independent variables constant. The Tobit betas can therefore be interpreted in the same way as the betas from an ordinary least squares regression (OLS) with respect to the partially latent variables.[31] The Tobit coefficients reported in this research are interpreted in relation to the underlying latent variable (WTP bids for non-censored observations and the unobservable observations above and below the censor points) that can be considered as the household's propensity or willingness to pay for riparian area preservation.

IV. EMPIRICAL RESULTS

A. Visitor Profiles and Preferences

The mean age of the visitors participating in the survey was 55 years. Almost half had completed graduate or professional school. The survey population was evenly divided between those who are employed full-time and retired persons. The mean household income of these respondents in the year 2000 was $94,000. Over 72 percent of the survey respondents indicated that they were members of organizations that supported conservation, environmental, or wildlife concerns. The organizations most often cited were The Nature Conservancy, the Audubon Society, and the Sierra Club.

The average group size was 3.6 persons, with a median of 2. Overnight visitors spent an average of 4.7 nights in the study area. Of all visitors sampled, 52 percent were repeat visitors to the Upper San Pedro River Basin. The vast majority of respondents (87 percent) list birding as either the main purpose of their trip (62.7 percent) or one of several important reasons (24.3 percent).

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30. GREENE, *supra* note 24, at 912–14. It should be noted that the formula for pseudo R^2 (as presented by STATA, a second statistical package used to verify the analysis) is, in effect, a reworking of the model chi-squared χ^2, which is $2(L_1-L_0)$. Therefore, this research reports the model chi-squared and its p-value, not the pseudo R^2. William Sribney, *Pseudo-R^2 for Tobit*, STATA Statistical Software for Professionals, *at* http://www.stata.com/support/faqs/stat/pseudor2.html (last visited Mar. 6, 2005).

31. BREEN, *supra* note 27, at 28.

B. WTP Model

The WTP model was estimated through a heteroskedastic Tobit model using the statistical software LIMDEP (version 7.0). The heteroskedastic model is reported here because the likelihood ratio test strongly rejected homoskedasticity (Table 4). The likelihood ratio test result for the heteroskedastic tobit is $\chi^2(6) = 199.36$. The critical value at the 0.5 percent significance level is $\chi^2_{0.005}(6) = 18.54$.

Table 4: Likelihood Ratio Tests

Constrained versus Regular Model (6df)	Baseline Model LL_0	Regular Model LL_1	$-2(LL_0- LL_1)$
	-3,240.91	-3,183.18	-2[(-3240.91-(-3,183.18)] = 115.46
Regular tobit (6df) versus Heteroskedastic tobit (6df)	Regular Model LL_1	Hetero-skedastic Model LL_2	$-2(LL_1- LL_2)$
	-3,183.18	-3,083.92	-2[(-3,183.18 - (-3,083.92)] = 198.52

The heteroskedistic Tobit model contained six independent variables regressed on the dependent variable WTP (Table 5). The model included behavioral, demographic, and economic variables.

The "income" variable was included in logarithmic form. The variable was positive and significant, indicating that WTP increased as income increased. Those respondents most able to pay for preservation were more likely to state positive and higher WTP amounts, implying that riparian area preservation is a normal good.

A second economic variable, "expenditure" per person per day (in the study area), was also specified in the model. This variable was positive and significant. The higher the visitor's expenditures in the study area, the higher their WTP. The amount visitors actually pay to enjoy the areas is positively linked to their WTP to preserve it.

Table 5: WTP Heteroskedastic Tobit Model

Dependent variable	WTP (actual)
Number of observations	551
Iterations completed	141
Log likelihood function	-3,083.923
Lower Bound	0.00
Upper Bound	1,000.00

Variable	Coefficient	Standard Error	b/se	P[|Z|>z]		Mean of X
Primary Index Equation for Model						
Constant	-27.454	99.326	-0.276	0.782		
ln_income	22.573	8.260	2.733	0.006	***	11.159
Expenditure	0.571	0.217	2.629	0.008	***	63.739
repeat_visitor	37.388	15.600	2.397	0.016	**	0.434
ln_age	-53.629	26.122	-2.053	0.040	**	3.949
ln_days_birding	5.161	3.896	1.327	0.184		2.824
Member	-0.61	14.250	-0.043	0.965		0.773
Heteroscedasticity Term						
ln_income	0.213	0.044	0.000	0.000		11.159
Expenditure	0.007	0.000	0.000	0.000		63.739
repeat_visitor	0.370	0.041	0.000	0.000		0.433
ln_age	-0.170	0.093	0.069	0.097		3.949
ln_days_birding	0.068	0.014	0.000	0.000		2.824
Member	0.238	0.065	0.003	0.003		0.773
Disturbance standard deviation						
Sigma	8.579	5.441	1.577	0.114		

** Significant at 5% confidence level
***Significant at 1% confidence level

The first behavioral trait addressed was the dichotomous variable "repeat-visitor," which represented respondents who had visited the study area in 1999 and 2000 and intended to return to visit the SPRNCA within a two-year period, given the riparian area remained healthy. A positive response to this dummy variable suggests a high propensity to visit the study area. The positive sign of the "repeat-visitor" variable indicates that the more active the visitor, the higher the willingness to pay. This finding suggests that repeated visitation (repeated non-consumptive use of the resource) is a positive influence in WTP contributions; however, other survey data qualify this interpretation. For instance, a follow-up question to the WTP bid asked respondents (only those who indicated a positive WTP) the reason that best described their WTP for riparian area preservation.[32] Less than eight percent of the positive bid respondents indicated that being a regular visitor was the reason that best explained their contribution. Eighty

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32. This question only pertained to respondents who made a positive bid.

percent indicated existence value as the reason best explaining their contribution. Consequently, we believe that motives for positive bids generally are based on existence values rather than on repeated use itself. The second behavioral variable, "days bird-watching" in logarithmic form, is not significant. Our study does not detect a relationship between the WTP bid and the number of days each year that respondents spend bird watching.

The variable "age" (in logarithmic form) is significant but negative. The variable "member" represented respondents who were members of an organization that supports conservation, environmental, or wildlife concerns. The membership variable was not significant. Overall, however, the results suggest that there are statistically significant and theoretically reasonable relationships between WTP responses and the explanatory variables.

The model estimated a mean WTP of $79.31, in the form of a one-time contribution for preservation of the SPRNCA. It is interesting to compare this model-generated estimate with the mean WTP generated from direct descriptive statistics on the raw WTP data, $78.50. These two figures are almost identical, suggesting the model accurately predicts WTP.

C. Aggregate WTP

The data collected pertained to only one incremental change in riparian habitat quality and so a marginal benefit curve cannot be constructed. However, the estimated mean individual WTP can be applied to the total visitation to estimate the aggregate WTP for riparian habitat preservation across all visitors. In this study, the aggregate WTP is based on visitor logs for the Ramsey Canyon Preserve and visitor estimates for the SPRNCA

The procedure of using the mean WTP to estimate aggregate WTP is commonly used in contingent valuation studies.[33] The aggregate total benefits represent the mean WTP multiplied by the total annual estimated visitation at the two visitor sites (Table 6).

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33.   *See, e.g.,* L.D. Sanders et al., *Toward Empirical Estimation of the Total Value of Protecting Rivers,* 26 WATER RESOURCES RES. 1345 (1990); Kristina B. Crandall et al., *Valuing Riparian Areas: A Southwestern Case Study,* 3 RIVERS 88, 95–96 (1992); Kirchoff, *supra* note 21, at 200.

Table 6: Aggregate WTP Estimates

	Annual Visitor Estimate	Mean WTP ($)	Aggregate WTP (Millions $)
High (+25%)	44,090	$78.50	$3.461
Middle	35,272	$78.50	$2.769
Low (-25%)	26,454	$78.50	$2.077

The monthly visitation patterns at Ramsey Canyon Preserve were estimated using a sign-in log at the visitor center. Knowledgeable observers indicate that one in five visitors is not represented by the visitor book sign-ins, resulting in an annual visitation estimate of 19,380 for the year 2000–2001. In comparison, during the fiscal year 1991–1992, 26,307 people visited Ramsey Canyon.[34] Staff familiar with Preserve visitation patterns suggests that the stock market decline and its financial ramifications for retirees, along with the introduction of an entrance fee at the Preserve in August 2000, contributed to the lower visitation numbers in 2000–2001.

Estimating an annual visitor count for the SPRNCA is more challenging. Visitor records are not collected for the SPRNCA. In addition, the survey contact point for this study represents just one of several access points to the 56,000-acre conservation area. To provide an estimate of total annual visitation at the site, we compared our daily visitor counts on survey collection days at the San Pedro House to the more formal visitor records maintained at the Ramsey Canyon Preserve. This comparison indicated that the non-resident visitor count is similar at both Ramsey Canyon and the San Pedro House entry point to SPRNCA. However this count does not include visitors entering the SPRNCA through other access points. Knowledgeable staff estimate that visitation through other access points likely accounts for one-third more SPRNCA visitors (5814 visitors). The annual visitation at the SPRNCA, therefore, is estimated at 25,194.

To estimate aggregate WTP by non-resident visitors to the SPRNCA and Ramsey Canyon, each non-resident visitor to the two sites must be counted only once. To avoid a double count of visitors who went to both sites, the total visitation estimate was adjusted. The survey results indicate 48 percent of the Ramsey Canyon visitors also visited SPRNCA. Total annual non-resident visitor estimates for the two sites

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34.   Kirchoff, *supra* note 21, at 113.

have been adjusted downward to 35,272 (for the year June 2000 to May 2001) in order to count each non-resident visitor only once.

V. CONCLUSIONS

The aggregate monetary WTP by non-local visitors for riparian area preservation in the form of a one-time contribution to a non-profit foundation was $2.769 million, with a range that varies from $3.461 to $2.077 million depending on whether one uses a high or low estimate of annual non-local visitors. These WTP measures are only one facet of economic benefits associated with this desert riparian habitat. It is beyond the scope of this study to measure overall economic value associated with preserving this riparian corridor. Such a comprehensive effort would need to include use and non-use values held by local residents, many of whom use the area for recreation. A comprehensive valuation would include regional flood control and water filtration benefits provided by riparian vegetation. A comprehensive economic valuation also would need to measure this area's significant contribution to migratory bird diversity and numbers throughout the Americas. Many trans-American bird species migrate through, or nest in, this corridor. While this study does not examine all benefits and costs associated with preserving this riparian habitat, it does identify significant economic benefits to non-resident visitors and it provides information useful to decision makers who must weigh the tradeoffs of managing the region's water for differing purposes.