VALUING RECREATION AND ENVIRONMENTAL FLOWS IN THE COLORADO RIVER DELTA UTILIZING THE CONTINGENT VALUATION METHOD

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Contents

Executive Summary

The overarching goal of this contingent valuation methodology study is to determine visitors' willingness-to-pay for a guaranteed source of water needed to sustain the Colorado River Delta's ecosystem. The median WTP was estimated from the responses of surveys conducted during Holy Week at five different recreation locations in the Colorado River Delta. The locations surveyed were: Campo Mosqueda and Campo Baja Cucapah (along the Hardy River, a tributary of the Colorado River), Morelos Dam and San Felipito (along the Colorado River), as well as the Cienega de Santa Clara wetland.

The survey included questions concerning their expenditures, activities, reasons for choosing that particular site, visitation patterns, knowledge and importance of conservation in the area, and demographic information. The key component of the survey, however, was the willingness-to-pay section. The respondents' WTP was elicited through a hypothetical scenario in which the respondent was asked if they were willing-to-pay a specific amount to enter the site knowing that the site would be guaranteed to have an adequate amount of water to support the Delta ecosystem.

A total of 584 surveys were used in the logistic model regression analysis and the results suggests that the median WTP is:

> $168 pesos (approximately $13 USD)[1] at sites along the Hardy River (Campo Mosqueda and Campo Baja Cucapah)
>
> $97 pesos (approximately $7 USD) at Morelos Dam, San Felipito, and the Cienega de Santa Clara.

[1] MXN peso-USD dollar conversion as of 8/5/12.

Introduction

The Problem and its Context

The Colorado River Delta (Delta), a once massive and vibrant delta ecosystem in northern Mexico, has been severely affected by the construction and operations of dams and diversions along the Colorado River. Prior to dams being built, the Delta covered approximately 2 million acres (800,000 hectares) and Colorado River water supported the Delta's extensive riparian, wetland, and estuarine ecosystems (Zamora-Arroyo et. al, 2005). The massive diversions of water for 3 million acres of irrigated agricultural land and for more than 25 million municipal water users in both the United States and Mexico have left very little water for the Delta and the Upper Gulf of California (Wheeler, 2007). Today, this lack of water has reduced the Delta to approximately 10% of its original size (Zamora-Arroyo et. al, 2005).

Despite the radical alterations in water availability, the Delta is still recognized as an immensely important ecological zone. The Delta provides habitat for over 350 species of birds, 24 protected Mexican species, several U.S. protected species, and other resident fish, marine mammals, and wildlife (Nagler et al. 2009; Hinojosa-Huerta et. al 2005). In addition to the habitat provided for year-round wildlife, the Delta provides a vital stopover for birds migrating on the Pacific Flyway. It is estimated that almost 200,000 shorebirds and 60,000 ducks and geese use the Delta wetlands as wintering grounds or for stopovers on migratory routes (Morrison et al. 1992, Mellink et al. 1997), and at least 110 species of neotropical landbirds use the Delta as a migratory stopover (Patten et al. 2001).

In addition to its national and international recognition as an important area for biodiversity and bird species, the Delta provides key cultural resources for local communities.

Indigenous communities such as the Kwapa (also known as the Cocopah tribe in Mexico and the Cucapah tribe in the United States) rely on the Colorado River and the Delta to keep their indigenous culture alive. Furthermore, the Colorado River, Hardy River (a tributary of the Colorado River), and wetlands of the Colorado River Delta provide a place for local communities and tourists, alike, to participate in recreational activities. Many Mexican and American families spend holidays and other vacations enjoying the nature opportunities that the Delta provides.

Unfortunately, the water that currently sustains the Delta arrives there inadvertently and with no assurances regarding volume, timing, and water quality. The Delta is sustained by agricultural runoff, inadvertent operational releases, and the very infrequent flood control releases (Wheeler et. al 2007). The only exception to this is the Las Arenitas wetland that is supported by effluent from the wastewater treatment plant. Until recently, there were no mechanisms to ensure that water will reach, support, and sustain the Delta's ecosystems. This unreliability of flows for the Delta is expected to worsen due to projected increases in demand from municipal uses and the uncertainty of the effects of climate change. All of these factors further imperil the survival of the Delta. Without assured water flows, the ecosystems of the Delta are at risk of disappearing. However, there are currently two mechanisms (the purchase of water rights and the purchase of effluent) that give back hope to the Delta. Each of these mechanisms, however, require significant funding to increase the flow.

In order to contribute further to the discussion of water management in the Colorado River, the purpose of this paper is to understand the economic value of recreation in the Delta and the value recreationists place on water for a healthy ecosystem. Demonstrating that the protection of the Delta's ecosystems has tangible benefits for the community and that the

community values healthy ecosystems can support decision-making when determining the appropriate allocation of scarce Colorado River resources. This report is the first in a series of projects that seek to understand the value of recreational activities in the Colorado River Delta. Whereas one report focuses solely on the value of the Delta for hunting recreationists, this study focuses on the value of a healthy Delta for all types of recreationists. The values presented in this study are representative of visitors to five specific sites in the Delta. The five recreation sites included in this study are: Campo Baja Cucapah, Campo Mosqueda, Morelos Dam, San Felipito, and the Cienega de Santa Clara.

Specific questions answered in this paper will be:

What are the socio-economic characteristics of the people that recreate in these five sites in the Colorado River Delta?

What are the characteristics of people who are willing to pay for conservation of the ecosystems in the Delta by contributing to a fund to acquire water?

What is the monetary value that Delta visitors place on the recreational activities and the protection of the Delta's ecosystems?

How can these answers lead to the creation of incentive-based policies to legally protect flows to the Delta?

Value of Water

While the value of water for agricultural, industrial, and municipal uses can be determined by the market price of water and the link that water has to productive and marketable outputs, the value of water for non-extractive uses is much more difficult to determine. Non-extractive uses, such as water for recreation and preservation of riparian and aquatic ecosystems,

have significant economic importance. However, because there is an absence of market transactions, the value of water for these uses must be determined outside of the traditional market valuation.

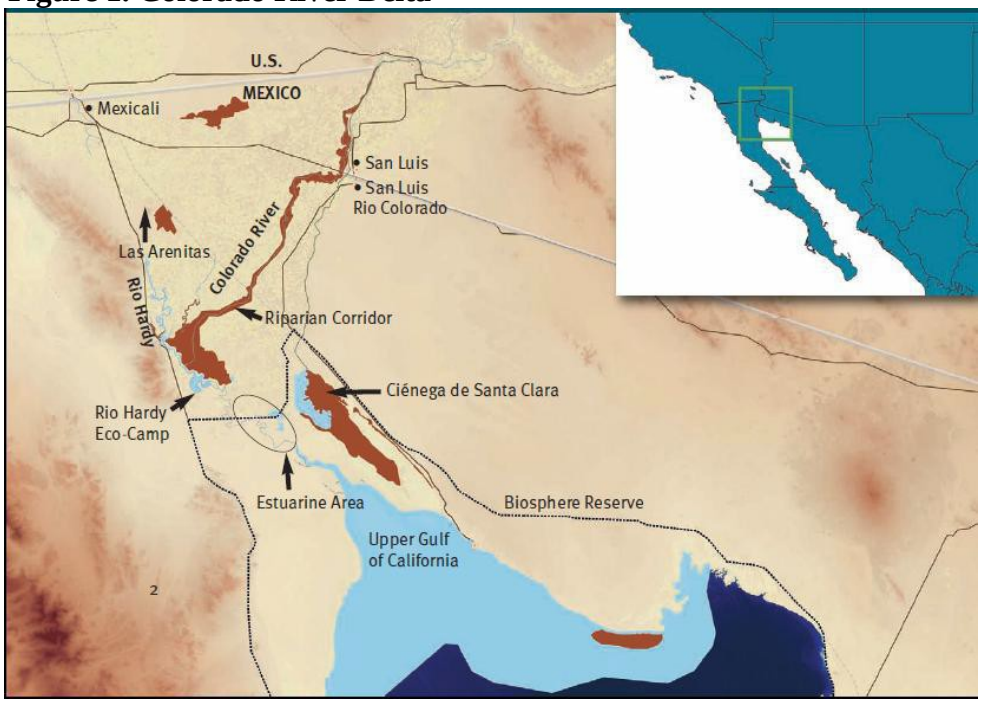
The method employed in this study is the widely-accepted contingent valuation method (CVM). The CVM is one type of non-market valuation that economists commonly use to assess the values of natural resources that are not captured by traditional markets. It allows for the inclusion of several different aspects of natural resource value. The first aspect of value that an individual can receive is from non-consumptive, direct use of the resource. Recreation is an example of this type of value. The individual is using the natural resource by being present in the recreational area, but is enjoying the area in a non-consumptive manner. Recreation, however, is not always a non-consumptive use of the resource. Hunting and fishing, for example, is a direct and consumptive use of the resource. A second category of value is non-use value. Non-use value is based on several motivations: existence value, bequest value, and option value. Existence value is the value that an individual places on the maintenance and protection of the resource. In this case, even though the individual doesn't use the resource, it has value because solely because of its existence. Bequest value is the value that an individual places on an environmental resource for the preservation of the resource for future generations. Again the individual may not currently use the resource, but places value on it because they'd like future generations to have the opportunity to enjoy it as well. Finally, option value also derives its value from the preservation of the resource for future use. Even though there may be a low likelihood that an individual will use the resource, they place value on preserving the resource because then they have the option of using the resource in the future.

The value of water for non-extractive recreational uses, and the value of water for the environment, is often not considered when making water management decisions. Nevertheless, difficult decisions will need to be made regarding the allocation of scarce Colorado River water resources, and it is imperative that the economic value of recreation and preservation of the Colorado River Delta's ecosystems is included in these decisions. The purpose of this paper is to quantify the value of recreation and environmental flows in the Colorado River Delta held by visitors to five sites within the Delta, and to better inform water management decisions in the Colorado River Basin.

The Study Area

The Colorado River Delta is located in Northern Mexico and spans two Mexican states, Sonora and Baja California (see Figure1). It is located in the arid Sonoran Desert and extends from the southern extent of the Colorado River (around Morelos Dam) to the Gulf of California (Wheeler, 2007, 918).

Figure 1. Colorado River Delta



The Colorado River Delta was formed approximately 2 million years ago. Glacial periods in the Pleistocene period brought abundant floodwaters and deposited sediments as it flowed to the Gulf of California, thereby molding the Delta into its current shape (Cardoso, 2006). Today, it covers more than 7,700 kilometers and is located within the area known as the Mexicali Valley.

The Mexicali Valley is also host to a huge agricultural presence. Approximately 576,620 acres or 233,350 hectares were in production in the Mexicali Valley in 2010 (SAGARPA 2010). The agricultural industry developed in this area due to the Colorado River's presence in the valley. The river's flows led to extremely fertile soils and the ability to irrigate crops. In fact, "more than 95% of the soil is classified agriculturally as first- or second-class" (Saille, Lopez, Urbina, 2006) and the primary source of water for the Mexicali Valley Irrigation District is the Colorado River, with additional water being pumped from groundwater aquifers (Schuster, 2012).

The valley is also host to two growing cities: Mexicali and San Luis Rio Colorado, which also depend upon the Colorado River and groundwater aquifers for water resources. Mexicali is the bigger of the two cities with almost 1 million people residents (936,826 in the 2010 Census), and San Luis Rio Colorado lies east of Mexicali with a little over 175,000 residents (178,380 in the 2010 Census) (INEGI, 2010). Astonishingly, Mexicali has grown by over 20% within the last 10 years, resulting in significant pressures on regional water supplies. Although not located within the Mexicali Valley, Tijuana also relies on the Colorado River for its source of water.

Aside from the large agricultural presence and burgeoning municipalities, the Mexicali Valley is also host to the once expansive Colorado River Delta. There are four major ecosystem

types in the Delta. The first type is the riparian ecosystem. Riparian ecosystems in the southwest United States and northern Mexico are typically comprised of native cottonwood and willow trees and non-native salt cedar. The riparian corridor follows the Colorado River from Morelos Dam to the confluence with the Hardy River (Zamora-Arroyo et. al, 2005). This ecosystem provides habitat for resident birds and an important route for migratory birds, including the endangered southwest willow flycatcher (Nagler et. al., 2009; Wheeler, et. al., 2007). The riparian corridor is supported by groundwater and agricultural return flow. Most importantly, this is one of the only areas along the entire Colorado River that still has a significant amount of native trees: the Delta's cottonwood-willow habitats are four times greater in acreage than the sum of all cottonwood-willow habitats found in the Lower Colorado River in the U.S (Wheeler, et. al, 2007). As such, this has resulted in a much higher bird density and diversity in the Delta (10 times as much) than in river reaches in the U.S. (Hinojoa-Huerta, 2006).

The second type of ecosystem present in the Delta is open-water wetlands, such as the Cienega de Santa Clara. The Cienega is the largest marsh wetland in the Sonoran Desert and is arguably the most important wetland in the Lower Colorado River Basin. The Cienega is comprised of dense cattail, open water, and mudflats. Its importance stems from the fact that this open wetland is a critical stopover for migratory birds, is the home to the world's largest population of the endangered Yuma clapper rail, and is an important habitat for the endangered desert pupfish (Zamora-Arroyo et. al, 2005; Hinojosa-Huerta, 2001; Varela-Romero, 2002). The Cienega is supported by brackish agricultural drain water provided by the U.S.'s Welton-Mohawk Irrigation and Drainage District's MODE canal. The importance of the Cienega has been recognized with its partial inclusion in Mexico's Biosphere Reserve of the Upper Gulf of California and Colorado River Delta established in 1993 (Zamora-Arroyo et. al, 2005).

The third ecosystem present in the Delta is the numerous brackish wetlands that exist in the midsection and other areas of the Delta (areas such as El Indio Wetlands, Pangas Viejas Wetlands, Andrade Mesa Wetlands, and El Doctor Wetlands) (Zamora-Arroyo et. al, 2005). These areas are comprised almost solely of salt cedar and other salt tolerant shrubs and vegetation. Although not ideal habitat, this non-native vegetation still provides important habitat for resident and migratory birds. Agricultural drainage from the San Luis and Mexicali agricultural valleys support these wetlands and vegetation stands (Wheeler, et. al., 2007).

The final ecosystem present in the Delta is the estuarine area at the mouth of the Gulf of California. This area is comprised of the intertidal, coastal and marine zone of the Gulf of California. Tides and freshwater from the Colorado River have historically supported a very rich estuarine area, but the lack of freshwater has left the quality and extent of the estuarine environment reduced. A statement in the Conservation Priorities document demonstrates the importance of this area by saying, "it is clear that these zones are presently functioning as breeding nursery areas for marine species, including shrimp, Gulf corvina, and the endangered totoaba-a large, high-quality endemic fish that was the basis for an early commercial fishery in the region" (Zamora-Arroyo et. al, 2005).

Survey Sites

The five areas selected for contacting visitors and eliciting values for recreation and environmental flows were scattered throughout the Delta. Two locations were on the Colorado River itself: a site at Presa Morelos (Morelos Dam) and a place called Vado San Felipito. Two locations were on the Hardy River, a tributary of the Colorado River: Campo Mosqueda and Campo Baja Cucapah, and the final site was at the Cienega de Santa Clara (see Table 1).

The Morelos Dam site is located near Morelos Dam, the diversion dam that provides water to the agricultural Mexicali Valley. The dam is located 1.1 miles (2 km) from the U.S.-Mexico border, where the California and Baja California land boundary intersects the river (IBWC) and within the state of Sonora and Arizona. At the dam, almost all of the Colorado River water is diverted into the Canal Reforma and taken to the agricultural Mexicali Valley. Visitors to Morelos Dam typically go to an open area near the dam to spend time with family, have picnics, and take part in community activities. For example, during Holy Week (the time of surveying), there is a small carnival that operates at the site. There are no services offered at this location.

Visitors to Morelos Dam.

Vado San Felipito is a bridge that crosses the Colorado River along the Sonora-Baja California railway and Carretera Luis B Sanchez el Faro highway. It is located approximately 6 km east of Guadalupe Victoria (GEER Association) and quite close to Kilometer 57 (Zamora personal communication). At this location, the Colorado River usually has water in the river, but there are some instances where the water is very shallow. There are no services or facilities at this location. People congregate at San Felipito primarily just to spend time with friends and family and have picnics, to race motorcycles or ATVs, or to swim. The name literally means "Little San Felipe" and is derived from the fact that visitors to this site see it as an alternative to traveling to the coastal city San Felipe.

Campo Mosqueda and Campo Baja Cucapah are privately owned "resorts". Campo Mosqueda is owned by the Mosqueda family, originally established in 1959 by Jesus and Romelia Mosqueda. It is located at Km. 53 ½ on the highway to San Felipe, approximately 45 minutes from Mexicali. This site offers a restaurant, a conference room, river front palapas (shade umbrellas) with barbeque grills, a sand volleyball court, campsites with restrooms and showers, and rental pedal boats and kayaks (Campo Mosqueda). Visitors who come to Campo Mosqeuda can participate in water activities such as fishing, swimming, boating, water or jet skiing, kayaking or riding on pedal boats. Visitors can also ride motorcycles and ATVs on the nearby dunes. Others just enjoy picnics or day-trips to the river or camp overnight. The cost to enter Campo Mosqueda is around $20 USD for a day trip.

Campo Baja Cucapah is owned by Omar Escodero. It is located at Km. 48 ½ on the highway to San Felipe, near Colonia Terrenos Indios. Campo Baja Cucapah offers cabanas (cabins for overnight stays) that are complete with a kitchen, living room, and sleeping accommodations for five people. For day trips, the site offers the rental of palapas, or shade

umbrellas, as well as the use of picnic tables and small pedal-boats. Additionally, the site offers a "Canopy Tour" which is a zip lining and suspension bridge activity. The cost to enter Campo Baja Cucapah is $250 MXN pesos per vehicle, which includes the rental of a palapa for day use. Visitors staying overnight in the cabins are expected to pay $1100-$1300 pesos per day.

The Cienega de Santa Clara, as previously mentioned, is a very large open-water wetland. A portion of it is protected by the Upper Gulf of California and Colorado River Delta Biosphere Reserve managed by the Comisión Nacional de Areas Naturales Protegidas (CONANP). It is also recognized as an internationally important wetland by the RAMSAR decree (Carillo, 2005). Interestingly, in all federally protected areas in Mexico except the Cienega, visitors are required to pay an entrance fee to the site. Experts suggest that installation of fee booths has not been pursued because there are too many entrance points to the Cienega. So although the visitors to the Cienega are still required to pay the entrance fee, it is not enforced. Visitors to this area come for a variety of reasons including sport fishing, hunting, and bird watching. The Cienega attracts a significant amount of visitors from the United States due to the sport fishing activities (specifically bass fishing) offered at the site. The site also provides a few cabins and restroom facilities. The facilities, however, are not well taken-care-of.

Table 1. Survey Location Sites

Site Name	Location	Ownership	Services
Morelos Dam	Colorado River	Public	None
San Felipito	Colorado River	Public	None
Campo Mosqueda	Hardy River	Private	Many
Campo Baja Cucapah	Hardy River	Private	Many
Cienega de Santa Clara	Open Wetland	Public	Few

Contingent Valuation Method (CVM): Theory and Practice

Contingent Valuation Method

The *contingent valuation method* (CVM) is one of two major types of methods to determine the value of goods that are not sold in a market. The first type of method is an indirect approach that infers the value of a good based upon observations of consumers' actual behavior. This family of methods is called the *revealed preference method* because it is based on the observed consumers' preferences. The second type of method is a more direct approach in which consumers are given a constructed hypothetical situation via interviews or surveys in which they must choose the scenario that they prefer (Carson, 2011). This is called the *contingent valuation method* because the values reported by the respondents are contingent upon the constructed situation (or simulated market) that has been developed in the survey. It is also commonly called the *stated preference method* because the respondents directly respond to survey questions regarding the value of the good.

The basic methodology of the CVM is as follows. The CVM proposes a hypothetical scenario within a survey and elicits values from respondents by directly asking either: 1) how much the respondent is willing-to-pay (WTP) to obtain a desired good or service or 2) how much the respondent is willing-to-accept (WTA) in terms of compensation to give up a good or service currently possessed (Carson, 2011). In this way, economists can elicit how much the respondents value the good or service.

CVM surveys generally have six major components. The first is an introductory section that identifies the sponsor of the project and general information regarding the project. The second section usually asks questions to determine the respondent's prior knowledge and attitudes toward the good. The third section sets up the hypothetical scenario. It includes the

background information (ie; the problem), what the project is designed to accomplish, and how the project would be implemented and funded (Carson, 2011). Once the hypothetical scenario has been developed, the next section asks the respondent's WTP/WTA for the good. Following the WTP/WTA question, there are typically debriefing questions to make sure the respondent understood the scenario and that they answered honestly. Finally, the survey asks demographic questions.

Origins of CVM

The first proposals for using surveys as a method to understand the values of public and social goods were put forth by Bowen in 1943 and Ciriacy-Wantrup in 1947. Bowen's goal was to understand the value of "beautification of the landscape" and Ciriacy-Wantrup sought to put a value on soil conservation programs. In Ciriacy-Wantrup's publication, often credited for being the first published reference to the contingent valuation method, he discusses the difficulties of measuring the benefits of soil erosion prevention and asked people directly how much they would be willing to pay for soil erosion abatement programs. He further proposed the use of the CVM in his influential book "Resource Conservation: Economics and Policies" (1952), which is often considered the first textbook in environmental and resource economics (Carson, 2011).

Since the first implementation of a CVM study done by Davis (1963), the CVM literature grew slowly but steadily throughout the early 1970s. Influential CVM studies in this period include Weisbrod (1964), Krutilla (1967), and Brown and Hammack (1969). Around the mid-1970s there was a spike in CVM literature. This spike has been attributed to the Randall, Ives, and Eastman (1974) CVM study that was published in the first volume of the *Journal of Environmental Economics and Management* publication. The publication of this study

essentially brought CVM into the limelight, and since then the CVM literature has grown very quickly, almost at an exponential rate until the mid-1990s (Carson and Hanemman, 2005).

During this 20-year period, the CVM approach gained credibility and respectability. In 1979, the Water Resources Council published regulations stating the CVM as one of three recommended methods for determining project benefits in water-related Federal agencies such as the U.S. Army Corps of Engineers (COE) and the Bureau of Reclamation (BOR). Then, in 1983, the EPA commissioned a state-of-the-art assessment of the CVM, with a panel of the prominent economists and psychologists, including several Nobel Laureates. The results of the panel suggested that although significant challenges remained, the CVM was a promising method to understand the value of goods not sold in a market. Finally, the landmark decision by the U.S National Oceanic and Atmospheric Administration (NOAA) in the 1992 Blue-Ribbon Panel co-chaired by two Nobel Laureates, Kenneth Arrow and Robert Solow, gave further legitimacy to the CVM. The Panel was convened in response to the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska, where the goal was to determine whether the natural resource damage could be reliably measured by the CVM. The Panel concluded that "CV studies can produce estimates reliable enough to be the starting point for a judicial or administrative determination of natural resource damages-including lost passive-use value" (Arrow, et. al. 1993, 43).

Nevertheless, opponents of CVM argue that the approach taken may not reflect the true WTP of the respondent. They argue that: 1) respondents do not take the hypothetical scenario seriously because no money is actually changing hands, and 2) that people act strategically and answer in a way that could be inconsistent with their true WTP for a public good. In either case, opponents are concerned that the estimates will be inflated above the true WTP. It is important to note, however, that these issues have been addressed by Carson et. al (1996) in his meta-

analysis of CVM studies. The results of his analysis suggest that when comparing CVM estimates to estimates based on revealed-preference studies, the CVM estimates were on average slightly lower (Carson, 2011).

With the stamp-of-approval from some of the most prominent economists in the world and the continued research on its effectiveness and accuracy, the CVM has gained acceptance as a useful tool to assess the value of goods not sold in traditional markets. As such, the amount of CVM literature published has grown to be approximately 500 papers per year (Carson and Hanemman, 2005).

Use of CVM for Non-Market Value of Water-Dependent Ecosystems

There are numerous studies that have used the contingent valuation method to understand the economic value of instream flow, and almost all of these studies use recreation as a basis for the evaluation. Daubert and Young (1981) used the CVM to value the recreational demands for maintaining instream flows for trout fishing, white-water boating (kayaking and rafting), and streamside recreation (such as picnicking, camping, or hiking) on the Cache la Poudre River in northern Colorado. Loomis (2012) contributed to the water-dependent ecosystem literature by conducting a CVM study that was able to tease out recreational value and non-use value from the total economic value of instream flows in the Poudre River in Fort Collins, Colorado.

Instead of focusing on recreation as basis for evaluating the value of water-dependent ecosystems, Mathis, Yoskowitz, Montagna, and Richardson (2008) conducted a CVM study to determine the value of instream flows by focusing on the effects that lack of freshwater have had on rivers, marshes, and the estuary in the Rio Grande in Texas. In this case, respondents were

asked how much they would be willing to donate to a fund to protect freshwater flows to the ocean.

The two most relevant publications to this study were conducted by Ojeda, Mayer, and Solomon (2008) and Rivera and Cortes (2007). These two publications stand out in the literature because of the location of the WTP surveys: Mexico. Ojeda, Mayer, and Solomon (2008) conducted a CVM study in Mexico to understand the economic value of environmental services provided by restored instream flows in the Yaqui Delta. The issues there are analogous to those in the Colorado River Delta. The Yaqui River begins somewhere around the U.S.-Mexico border, travels through the Mexican state of Sonora, and is supposed to meet the Gulf of California. Similar to the Colorado River Delta, however, the river has not reached the Gulf in many years. This study used the CVM to survey 40 neighborhoods in the Delta's most populated city, Ciudad Obregon. The respondents were asked a WTP question regarding their willingness to purchase water for environmental flows through higher water bills. The surveys were conducted in-person and the results indicated that households would be willing-to-pay an average of $73 MXN pesos each month.

Rivera and Cortés (2007) produced the most relevant research for this study, and was used as a guide for the development of our CVM study. Rivera and Cortés of the National Institute of Ecology (Instituto Nacional de Ecología, INE) published an article with the assistance from Yamillett Carrillo of Pronatura Noroeste entitled "Valoración económica de la actividad recreativa en el río Colorado" in Región y Sociedad. The publication was written in Spanish. The purpose of this study was to understand the value of informal recreation activities along the Colorado River. They called these informal recreation activities because there was no cost to enter the sites, nor were there services available. The surveys were conducted during the

spring of 2005, when there was water in the Colorado River and one of the sites was the same site used in this study, Vado San Felipito. They had 100 respondents, mainly from San Luis Rio Colorado, with 85 of those surveys usable in the calculation of the median WTP. The WTP question asked the respondents how much they were willing-to-pay to guarantee that the Colorado River would have water at all times. The results of this study suggest that people are willing-to-pay around $45 MXN pesos to guarantee water in the river. Because a large majority of the respondents were from San Luis Rio Colorado (95% of the respondents), this study was able to estimate the range of total annual benefits. Knowing the population of San Luis Rio Colorado (35,000 occupied houses), the average number of visits that respondents take to the river (1.86 times per year), and the median WTP (45 pesos) they calculated that the range of total annual benefits ranged from 1.9 to 6 million pesos annually.

Methodological Challenges of CVM

Although it seems as if conducting a CVM survey would be simple and straightforward because it is just asking the respondent whether they are willing-to-pay for a good in a non-traditional market, serious care must be taken in the methodology and design of the survey. Mitchell and Carson's (1989) book, *Using Surveys to Value Public Goods: the Contingent Valuation Method*, highlighted the types of biases and misspecifications that can occur if the survey is not carefully designed (Carson, 2005). Careful consideration must be taken when selecting the type of survey methodology and designing the survey.

Survey Methodology

The survey can be administered to respondents in a number of ways. Common methods include using US postage mail, telephone, or in-person interviews. Mail surveys have the advantage that they are the least expensive and can be void of any bias an interviewer may produce, but they also typically have lower response rates and may not be able to effectively communicate complex scenarios. Telephone surveys are also generally cheaper than in-person interviews, but can be seen as impersonal and may not be relevant for the target population. Finally, an enumerator can administer the survey in-person. This can be done one of two ways: the respondent can read and respond to the survey him/herself or the enumerator can read the survey to the respondent. The method chosen in this study was to conduct in-person surveys, the details of which are in the methodology section.

Survey Design

As alluded to previously, the survey design is very important to the efficacy of the CVM study. Specifically, care needs to be taken when developing the WTP scenario, choosing the

payment elicitation method, and choosing the payment vehicle. This section outlines the considerations that need to be made when developing the willingness-to-pay section of the CVM survey.

Development of Scenario

The development of the scenario is one of the most important sections of the CVM study. This is where the constructed market is developed and the data for the estimation of the value of the good is elicited. This section should be as clear, concise, and neutral as possible. The respondent should be given enough information to make an informed decision, but the amount and content of the information should not overwhelm or bias the respondent. It should be carefully designed to avoid any confusion or misunderstanding between the interviewer and the respondent. Furthermore, it is imperative that the constructed market is meaningful, realistic, and plausible. If the respondent does not believe that this market is feasible or realistic, their true value may not be captured.

The scenario should include a baseline of the current situation and must "convey the change in the good to be valued, how that change would come about, how it would be paid for, and the larger context that is relevant for considering the change" (Carson, 2005). Again, this should be as clear and concise as possible in order to avoid misunderstandings between the respondent and the enumerator.

Payment Elicitation Method

Another important decision to be made is to choose the payment elicitation method, or the way in which the respondent is asked for their WTP. Two commonly used elicitation methods are open-ended and closed-ended questions. Open-ended questions, not as commonly

used in today's CVM studies, ask the respondent's WTP and let them answer freely. An open-ended question would ask : "What is the maximum amount of money you would be willing to pay for…?". In this case, the respondent can answer with ANY value. This type is seen as more difficult for respondents to answer, especially if the respondent is unfamiliar with valuing a natural resource.

The second way to do it is ask a closed-ended question. Closed-ended questions can take many forms including the use of a dichotomous choice question, or the use of payment cards or a bidding game. The dichotomous choice question, also known as the take-it-or-leave-it question or referendum question, presents a randomly assigned amount and asks the respondent for a simple "yes" or "no" of willingness to pay that specific amount. The amount varies by respondents and can therefore trace out a demand curve over the entire sample. The benefits of using this form is that it doesn't require much effort on the part of the respondent and it is familiar to respondents because the decisions to "buy" is similar to ordinary market decisions that a person has to deal with everyday. A bidding game starts originally as a dichotomous choice question: an amount is proposed to the respondent and they choose whether they are willing-to-pay that amount or not. If the respondent states that they are willing-to-pay the proposed amount, the amount is then raised and the respondent is asked if they are willing-to-pay again. This process is continued until a "no" WTP is reached. The highest "yes" amount is recorded as the respondent's maximum WTP. The advantage of this type of elicitation method is that it allows the surveyor to hone in on a more accurate WTP value. Finally, there is the payment card method in which the respondent chooses the maximum they would be willing-to-pay from a range of values. This has the advantage in that it is doesn't require much effort from the respondent, but also must be designed carefully so as not to produce starting point bias.

This CVM study asks two similar WTP questions with two different payment elicitation methods. The WTP question of the utmost interest followed the dichotomous choice method and the second question followed the payment card format. More detailed information about the reasoning and methods used in this particular CVM study is presented in the methodology section.

Payment Vehicle

The final major decision to be made when designing a CVM study is to choose the payment vehicle, or the mechanism in which the respondent would hypothetically pay for the good. Once the hypothetical market has been established to value the good, there must be a mechanism through which the respondent would pay the amount specified in the valuation process. Typical payment vehicles include higher taxes, higher product prices or total bills, entrance fees, or payments to a designated fund. This CVM study used an entrance fee as the payment vehicle.

Methodology

The overarching goal of this contingent valuation study is to determine visitors' willingness-to-pay for an entrance fee in order to guarantee a source of water needed to sustain the Colorado River Delta's ecosystem. The WTP was estimated from the responses of surveys conducted during Holy Week (April 6, 2012-April 8, 2012) at five different recreation locations in the Colorado River Delta. The survey included questions concerning their expenditures, activities, reasons for choosing that particular site, visitation patterns, knowledge and importance of conservation in the area, and demographic information. The key component of the survey, however, was the willingness-to-pay section. The respondents' WTP was elicited through a hypothetical scenario in which the respondent was asked if they were willing-to-pay a specific amount to enter the site knowing that the site would be guaranteed to have an adequate amount of water to support the Delta ecosystem. The analysis of this data was conducted in SAS, a statistical programming software, using the logit regression model (the standard regression for this type of CVM study). The analysis will result in a median WTP over the whole sample and the determination of which factors/variables influence the respondents' WTP for the good. If there were estimates of visitor numbers to these sites in the Delta, an aggregate WTP would also be calculated.

The methodology presented here is in chronological order starting with a detailed account of the considerations made in the design of the survey, the steps taken to prepare for implementation of the survey, and the actual implementation of the surveys.

Survey Design

As stated before, the design of this survey is based upon a survey developed and conducted by Rivera and Cortes (2007) of the Instituto Nacional de Ecologia (INE) with

assistance from Yamilett Carrillo of Pronatura. The article was published in Spanish in *Region and Society* in 2007. Major modifications were made to this survey to broaden the scope of the project to the Delta and to focus specifically on the WTP for a guaranteed source of water to support the health of the Delta ecosystem.

Components of Survey

When designing the survey it was important to think about the factors that would contribute to whether a respondent would be willing-to-pay for an entrance fee in order to guarantee adequate amounts of water to support the health of the Delta's ecosystems. Factors affecting the likelihood of a respondent being willing-to-pay for entrance to the recreation site will be a function of the frequency that they use the site, the activity that they participate in, their beliefs about the importance of Colorado River Delta and conservation in general, and general demographics such as age, education, and income. To cover these topics, the survey comprised four distinct sections:

1. Visitation information
2. Use and conservation of the ecosystem
3. Preferences about the Colorado River Delta, and
4. Demographic information.

The first section of the survey had two separate components of visitation information. The section began with questions regarding the respondent's visit on that particular day. The respondents were asked how many people were in their party, their expenditures, the length of time they were planning to stay, and the activities that they came to partake in. The subsequent section referred to any past visits they had taken to the site. If the survey date was their first trip

to the site, the respondent could skip to the next set of questions. Otherwise, the respondent was asked the average amount of time they stayed in the recreation site, whether they had seen the recreational site dry, the activities that they normally come to partake in, and the season that they prefer to visit the site.

The second section was developed to help understand the respondents' awareness of the Delta ecosystem and the importance that they place on conservation of the environment. The respondents were asked if they have heard or read about the Delta's significance to the region in the last few years. These questions were specifically designed to elicit an honest response from the respondents. The original question asked if they were aware that a protected area, the Upper Gulf of California and Colorado River Delta Biosphere Reserve, existed. Upon further review, however, we decided to re-word the question to ask if they had *heard* or *read* about the Biosphere Reserve to address any false positives, or people saying that they were aware of the Reserve to appear knowledgeable or prevent embarrassment. They were also asked a couple questions regarding the level of importance that they place on conservation practices. On a 5-point likert scale, the respondent was asked to indicate the importance of designating a secure supply of water for the environment, such that the water level is adequate to maintain the health of the ecosystem. Similarly, they were asked to indicate the importance of taking part in conservation efforts to maintain habitat for native species.

The third section was the heart of the CVM study because it was the portion of the survey that elicited the respondents' WTP. It constructed the hypothetical market by giving some background information, the proposed changes, the WTP questions, and a follow-up question for a select group of respondents. The details of this section will be elaborated upon in the next two segments of this paper.

The final section of the survey asked general demographic information such as the respondent's age, gender, marital status, occupation, education and income. At the end of the survey the respondent was also given the opportunity to make any comments or suggestions about the survey or the situation in general.

Scenario

The scenario, or hypothetical market, for this study was developed so that the respondent could place value on securing adequate amounts of water to sustain the Delta's ecosystem. The market was constructed by: 1) giving background information regarding the status of the Delta ecosystem today (the baseline/problem), 2) the proposal to address this problem, 3) how the project would be implemented and paid for, and 4) a value elicitation question to elicit the respondents' WTP.

The scenario presented to the respondents stated:

> "In recent decades, portions of the Delta's rivers and wetlands have dried due to lack of water flows. Conservation groups and visitors are concerned that inadequate flows are harming the flora and fauna of the region. Without adequate flows, the health of this ecosystem is threatened and local communities are faced with declining recreational benefits.
>
> Conservation groups and people who value this ecosystem and the benefits it provides to local people want to ensure that there are adequate amounts of water to sustain a healthy and vibrant Delta ecosystem. Funds for securing adequate water could be generated through various sources: one of these sources could be entrance fee collection booths at the main entrances of recreation sites such as this.
>
> Now, we ask you a series of questions regarding a possible entrance fee. In answering, please assume that the fees will be collected and managed by a non-profit trust responsible for securing water to sustain a healthy ecosystem. Please think carefully about your response and keep in mind that you would need to reduce expenditures on other items in order to contribute."

Payment Elicitation Method

The value elicitation questions directly followed the scenario. The first question followed the dichotomous choice payment elicitation method and asked:

> "Which of the following options would you prefer? (choose one)
>
> a) Pay [X] pesos per car per entry to this site and the site would be guaranteed to have adequate amounts of water to sustain a healthy and vibrant ecosystem.
>
> b) Do not pay for entry to the site, and have no assurance of water to help sustain the ecosystem. (sometimes there could be more water, sometimes less, as they release water from the United States)."

The fee amount in pesos per car varied across each survey and also varied depending on the location where the survey was conducted. If the survey was conducted along the Rio Hardy, at either Campo Mosqueda or Campo Baja Cucapah, the values varied for [X] representing one of the following fees: 20, 50, 100, 175, 275, or 400 Mexican pesos. The survey values were stratified so that the first survey began with the value of 20, the second 50, and so on so that each value would be represented in the sample approximately the same number of times. The same methodology for varying the fee amount was used for the three other sites, but their fee amounts were significantly less. For surveys conducted at the Cienega de Santa Clara, Presa Morelos, and Vado San Felipito the values of [X] varied equaling 10, 20, 35, 50, 70, or 100 Mexican pesos.

The range of values differs between the locations based upon information received from a previous survey conducted by the Sonoran Institute. During Holy Week of 2011, they conducted a similar survey where they determined the maximum amount a respondent would be willing-to-pay based upon an open-ended question. The results of the 2011 survey showed that the locations along the Rio Hardy, Campo Mosqueda and Campo Baja Cucapah, had a significantly higher median WTP as opposed to the other sites. The median WTP for these two sites was 100

Mexican pesos, whereas the median WTP for the other sites was only 35 Mexican pesos. This study followed the advice of Alberini (1995) and Kanninen (1993, 1995) and chose 5 to 8 values that were clustered around the median WTP as the range of values to be used as the values for the dichotomous choice question (Boyle, 2003).

A second WTP question was asked as a follow-up question to the first. This question followed the payment card elicitation format. The purpose of the second question and format was to hone in on the respondent's true WTP. This follow-up question asked:

> "If you had to pay, what is the **maximum** you would pay for entry (per entry/car) to the site in order to ensure that it has an adequate supply of water to sustain a healthy and vibrant ecosystem?"
> _____ $/car (per visit)

When the enumerator asked this question, they would then hand a separate sheet of paper with a list of values where the respondent could circle the maximum that they would be willing-to-pay. Again, the range of values differed depending on the survey location. Those respondents at Campo Mosqueda or Campo Baja Cucapah could choose from the following:

0	10	15	20	25	30	35
40	45	50	60	70	80	90
100	125	150	175	200	250	275
300	325	350	375	400	450	500

The respondents who were surveyed at the Cienega de Santa Clara, Presa Morelos or Vado San Felipito could choose from the following range of values:

0	5	10	15	20	25	30
35	40	45	50	60	70	80
90	100	110	120	130	140	150

Every respondent also had the option of providing a value that was not provided in the table.

Finally, if the respondent answered the last question with a maximum of $0 WTP, they were asked a follow-up question to determine whether it was a valid WTP bid of zero pesos ($0) or whether it was a protest bid. The difference between these two types of bids is that the respondent with a true zero peso bid believes and accepts the constructed market, but is not willing-to-pay for the natural good or service. A protest response, on the other hand, is when a respondent objects to the hypothetical scenario altogether. Slightly more detail will be given when the removal of ineligible surveys is discussed in subsequent chapters.

Enumerator Training

Prior to the survey implementation, a training session was offered for the enumerators in the last week of March 2012. Many of the enumerators were volunteers that assisted with Sonoran Institute's 2011 survey. The session was conducted via a teleconference with myself and Joe Marlow, economist for the Sonoran Institute, in Tucson, AZ and the enumerators in

Mexicali, MX. Francisco Zamora, Director of the Colorado River Delta Legacy Program at the Sonoran Institute, translated all communication. A copy of the training agenda is provided in the Appendix. Several topics were covered in the training session, one of which suggested that enumerators wear neutral clothing and avoid wearing shirts with logos or slogans to reduce the risk of biasing the respondents.

In addition to the training, each enumerator was given a checklist to help remind them of important tasks and to help facilitate the interaction with visitors/respondents. The enumerators were also given a tally sheet to track the number of visitors approached, the number of respondents who completed the survey, and the reasoning, if given, for non-participation. Both of these documents can be found in the Appendix.

Survey Implementation

The survey methodology chosen in this study was the in-person interviews with the enumerators reading the surveys to the respondents. This method was chosen for several reasons. First and foremost, this study is following the NOAA panel recommendations by using in-person interviews as opposed to telephone or mail surveys (Mitchell and Carson, 1989). Secondly, this study had considerable assistance from Sonoran Institute staff in the Mexicali office. There were almost a dozen individuals that were able to help in the administering of surveys at the five different locations. Finally, we chose to have the enumerators read to the respondents due to potential literacy problems[2].

The surveys were conducted during the weekend of Holy Week (Semana Santa) in 2012. Surveys were conducted on Friday, April 6th through Sunday April 8th. Over this timeframe, 674

[2] In one location, there were several respondents that requested to review the survey themselves. The enumerators agreed, and flagged those surveys that were not read to the respondent.

surveys were completed with 584[3] of them usable in the econometric analysis. The enumerators contacted all persons above the age of 18 to participate in the survey.

Table 2. Summary of Visitor Contacts

Location	People Contacted	People Declined	Completed Surveys
Campo Baja Cucapah	150	7	143
Campo Mosqueda	208	24	184
Cienega de Santa Clara	102	9	93
Presa Morelos	176	26	150
San Felipito	121	18	103

Data Handling and Removal of Ineligible Surveys

When conducting surveys, there are often cases in which some questions are not answered or not recorded. This can pose problems when the data analysis and econometric modeling is done. To combat this issue, there are two major avenues: 1) delete the entire record of observation, or 2) use statistical data from the remaining sample to fill in values for the missing information. Both methods were employed in this project.

In total there were 90 records deleted from the sample. As can be seen in the Table 3, this brought our usable sample to 584. The records that were deleted either had missing information on their income, age or gender or they were deleted because they had a protest zero response.

Table 3. Removal of Ineligible Surveys

Total Surveys Collected			674
	Deletions		
	Protest Response	45	
	Missing Income	42	
	Missing Age	1	
	Missing Gender	2	
	Total Deletions	90	
Useable Surveys			584

[3] Deletions from the original number of surveys completed is explained on page 34-35. Represents 87% of total sample.

All respondents who stated that they had a maximum WTP of $0 Mexican pesos were asked a follow-up question to determine *why* they were not willing to pay the entrance fee to contribute to the fund to acquire water. Responses that demonstrated that the respondent disagreed with the hypothetical scenario or the constructed market were considered protest bids. All zero bids were categorized as either a valid zero bid (in which the answer of $0 MXN was considered to be a genuine and true value) or a protest bid (in which the respondent disagreed with the scenario, felt that it was implausible, or disagreed with the means of collecting money). The table below shows the list of potential responses to a $0 bid as well as the number of responses that were considered valid and protest bids. Overall, 45 of the $0 bids were flagged as protest bids and deleted. The remaining 42 $0 bids were kept within the sample.

Table 4. Identifying Protest Responses

	Valid Response	**Protest Bid**
Reason that best explains the zero bid	**No. of Bids**	**No. of Bids**
Our party cannot afford to pay the entrance fee	30	
Any amount I pay would be too small to make an impact.		5
I do not think the deterioration to the Delta's health is urgent.	4	
I can go to other locations to enjoy nature.	8	
Water for the Colorado Delta should be acquired at no cost to me.		12
Local people will be unfairly burdened by paying for entrance.		2
I do not trust that the money would be handled correctly.		11
I need more information/time to answer this question.		3
Other reasons:		
Portions of the fees already charged should go to this fund.		12
Total Zero WTP Bids	**42**	**45**

Another legitimate way to handle missing information is to fill the variables missing with relevant values based on statistical measures. For example, in this sample, there were two

respondents who did not specify their level of education, one who did not answer their maximum WTP, and 5 who did not indicate the number of visits they make to the area. In order to fill these with appropriate values, we determined the median level of education, maximum WTP, and number of visits based on the respondents' income level. For example, the median education for a respondent with an income level of less than $40,000 MXN/year was secondary school. The education information was then inferred based on their income level. This methodology is consistent with the literature.

For other missing variables that do not necessarily relate to the respondents' income, the median over the whole sample was used. An example of this type of variable is *water_value*. The first variable related to a question in which the respondent answered the level of importance via a 5-point Likert scale for maintaining a water level high enough to support a healthy ecosystem. Two respondents did not respond to this question and were therefore given the median value of the whole sample, which was "1" (or very important). In the final analysis this variable needed to be re-coded to make more intuitive sense. Therefore, for the analysis "1" symbolized that the respondent considered it the least important and "5" was the most important.

Knowledge of the area and the area's prominence were two other variables that had several missing responses. These variables asked whether the respondent was aware that the Delta was part of a protected area called the Upper Gulf of California and Colorado River Delta Biosphere Reserve and whether they were aware that the Delta is known worldwide for its flora and fauna. It was assumed that if the question was not answered, the respondent was not aware of these things.

Other issues with missing information were handled in logical, systematic way. There were six respondents that did not answer the WTP dichotomous choice question. If we had not asked a follow-up WTP question of, "What is the maximum you would be willing to contribute?" and given payment card values, we would have had to delete these six observations. However, because we had the maximum WTP question, we were able to infer whether or not they would have answered "Yes" or "No" to the dichotomous choice question. If the maximum WTP was higher than the amount given in the dichotomous choice, we assumed that they would have said "Yes". If the maximum WTP was lower, we assumed that they would have said "No".

One of the biggest issues with the survey data dealt with the problem of "yea-sayers". A yea-sayer is a respondent who answers the dichotomous choice question positively for a certain amount, but then answers the follow-up question for their maximum WTP ***less than*** the amount in the dichotomous choice question. They are considered a "yea-sayer" because when asked directly if they would be willing to contribute, they say "yes" potentially because of societal pressure or to please the enumerator. This sample was particularly heavy with yea-sayers with 109 (or 18.6% of the sample) having this characteristic. Surprisingly, there were even six respondents who stated that they were willing to pay the dichotomous choice amount but also stated a maximum WTP of $0 MXN. All yea-sayers were flagged as such, and a variable called *TRUE_YES_WTP* was created. This variable is the dependent variable in the econometric analysis and was calculated where an observation with a positive response on the dichotomous choice question that has NOT been flagged as a yea-sayer is denoted as a true positive response (y=1). On the other hand, the dependent variable is equal to zero (y=0) when the respondent did not answer positively to the dichotomous choice question *or* when they answered positively, but

were flagged as a yea-sayer, therefore denoting that the answer to the dichotomous choice question was NOT their true WTP.

Due to the complexities of first-hand data collection there were several other issues to be addressed. For example, one question asks the number of hours the respondent stays at the recreational site. Most respondents answered in the approved format, but several answered "1 day". In this case, 1 day was assumed to be a working day, or 8 hours. Another problem in the data entry was a misunderstanding by the enumerator. Question #6 asked the respondent to rank the top two activities that they came to partake in on that particular trip. They were only supposed to mark two selections, and rank the two in order of preference. There were 108 surveys in which all-possible activities were marked with a "1" or a "2". These surveys were flagged, and any activities with a value of "1" were considered to be the main activity. A dummy variable was then created across all of the surveys where *d_water_recreation*=1 whenever an aquatic activity, swimming, or fishing were either ranked #1 or #2.

Initial Analysis

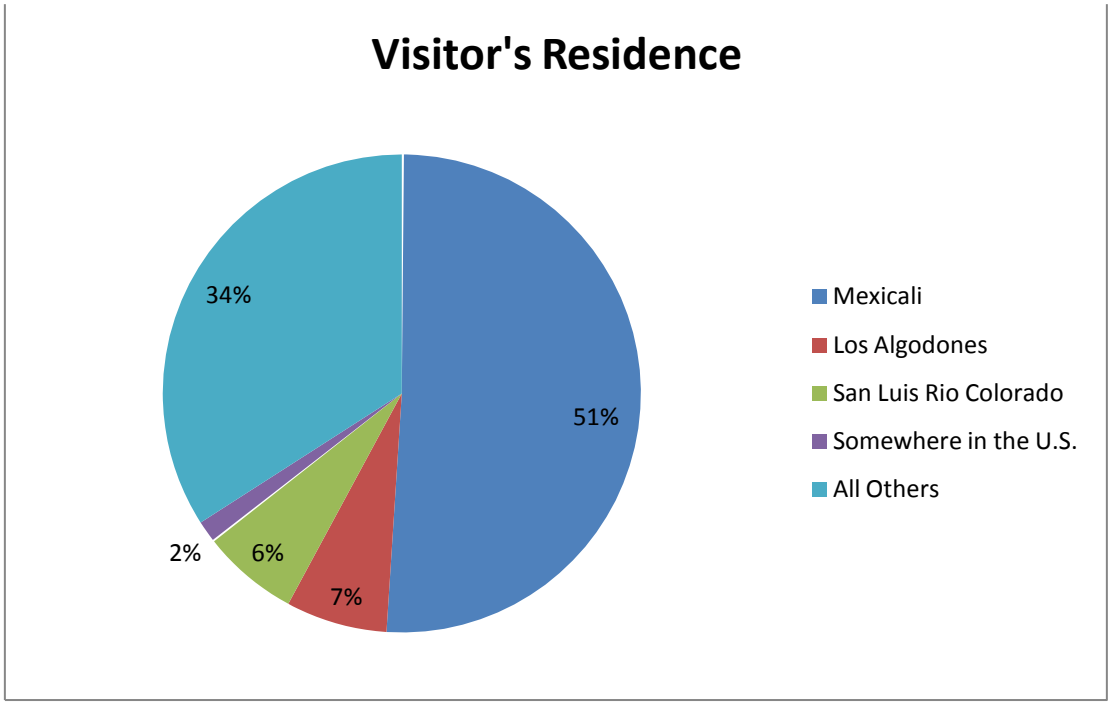
Visitor Profiles

The visitor profiles and travel pattern preferences of the 584 eligible respondents are presented in this section. Components covered in the visitor profile include the visitor's residence and the distributions of age, gender, level of education, and income. Travel pattern preferences includes whether the main reason for the trip is for a water-related activity and the frequency of their visitation to the site.

As shown in Figure 2 below, a large majority of visitors to the Delta's recreational areas during Holy Week are what we consider local visitors, or visitors who traveled less than 100

kilometers to arrive at the site. The figure shows the primary residence of visitors to all five Delta recreation sites. Over fifty percent of the visitors surveyed are from Mexicali, seven percent are from Algodones (located within the Mexicali Valley), and six percent were from San Luis Rio Colorado. While thirty-four percent of the visitors are from other locations, a large majority of these visitors are from the ejidos located in the Mexicali Valley.

Figure 2. Visitor's Residence



The visitors surveyed in the Colorado River Delta ranged in age from 15 to 78 years old (Table 5). The mean age of the visitors was 33, and 53% of the sample was male. Approximately 79% of the sample had an education level equal to or lower than high school attainment (Table 6), and the majority of the people sampled were in the $41,000- $80,000 Mexican peso annual income bracket.

Table 5. Distribution of Respondents' Age

Age (in years)	Frequency	%
15-19	42	7%
20-29	202	35%
30-39	186	32%
40-49	100	17%
50-59	40	7%
60-69	9	2%
70+	5	1%

Table 6. Educational Attainment of Respondents

Eduation Level	Frequency	Percent	Cumulative Percent
None	3	1%	1%
Elementary School	59	10%	11%
Junior High School	204	35%	46%
High School	195	33%	79%
University	114	20%	98%
Masters	9	2%	100%

As suspected, income levels differed depending on the location visited. Those respondents who visited locations along the Rio Hardy had a median annual income of $81,000-$125,000, whereas the median of those respondents at the other three sites were in the lower annual income bracket of $41,000- $80,000 Mexican pesos.

Only 9% of the sample stated that they came to the recreation site to join in some sort of water recreation (aquatic activity, swimming, or fishing). Somewhat surprisingly, almost half of the sample responded that the survey date was their first trip to the recreation site. The next most prevalent response was that the respondents come on average one time per year, with approximately 23% answering in this way (Table 7).

Table 7. Respondents' Average Number of Visits

Average Number of Visits	Frequency	Percentage
It's my first visit.	264	45%
Less than once a year.	53	9%
One time per year.	136	23%
2-5 times per year.	62	11%
6-10 times per year.	21	4%
More than 10 times per year.	48	8%

Econometric Model and Results

Willingness to pay for a guaranteed source of water to sustain a healthy Delta ecosystem was estimated and explained using a logit regression model using the statistical software, SAS (Version 8.3). The dependent variable was *TRUE_YES_WTP* which is a binary variable where *TRUE_YES_WTP*=1 when the respondent is willing-to-pay the fee amount proposed to them and they have ***not*** been flagged as a yea-sayer. Again, when the dependent variable equals 1 when the respondent has agreed to pay the fee amount (therefore has a true, positive WTP) and 0 when the respondent has not agreed to pay the fee amount. Of the total sample of 584 respondents, 343 visitors (59%) responded that they were truly willing-to-pay the fee amount proposed to them and 241 were not willing-to-pay. If yea-sayers had not been accounted for, there would have been an additional 109 respondents that stated that they were willing-to-pay the fee amount. This would have inflated the percentage to 77%.

The logit model specifies the probability of a "Yes" response to the WTP question. The logit regression model was selected for this study because it is the most common method used in the literature for calculating the median WTP. A more detailed description of the logit model is presented in the footnote[4].

[4] The general specification of the logit model is:

$$\frac{1}{1+e^{-(\beta_0+\beta_1 X_1+\beta_2 X_2+\ldots+\beta_n X_n)}}$$

Where the β values are the slope coefficients and the X values are the independent variables (the specific characteristics of each individual observation). The estimation of a logit model is done by maximum likelihood.

Once the WTP logit equation has been estimated, the median WTP over the whole sample can be calculated by using a formula from Hanneman (1984). The equation used to calculate the WTP is:

)

Where β_1 is the coefficient on the fee amount and $X_{m2}\ldots X_{mn}$ are the sample medians of the independent variables.

Model Variables

The model variables, their description, type of variable and expected signs are listed in Table 8. The expected sign denotes whether the variable is expected to have a positive or negative impact on a "yes" response to the proposed fee amount. A variable with an expected positive sign implies that this factor will increase the likelihood that a respondent will have a "yes" response. A variable with an expected negative sign implies that we think that this factor will decrease the likelihood of the respondent saying "yes" to the proposed fee amount.

The variable *No_Visits* has an ambiguous expected sign because the theory supports both signs. The frequency that a respondent visits the site could be an expression of the importance or value of the site to that person. In this case, we would expect the sign to be positive. However, for those respondents who visit the sites very frequently, they would be less likely to say "yes" to an entrance fee because they would have to pay each time they visited the site. Age and the dummy variable for male are also ambiguous because theory does not suggest whether these factors will increase the likelihood of a "yes" response to the dichotomous choice question.

Table 8. Variable Descriptions and Expected Signs

Variable	Description	Expected Sign
TRUE_YES_WTP	=1 if "Yes" on dichotomous choice and NOT a yea-sayer	Dependent Variable
Amount	Amount of fee proposed	-
Income	Annual family income	+
No_Visits	No. of visits to site	+/-
Water_Value	Likert scale of importance of water to support ecosystems	+
Age	Age of respondent	+/-
Education	Education level	+
D_Water_Recreation	=1 if Activity is aquatic activity, swimming, or fishing	+
D_Male	=1 if respondent is male	+/-
D_rio_hardy	=1 if on Rio Hardy (CM or CBC)	+

WTP Regression Model

The variables listed in Table 8 were used in the estimation of the logit regression model. The results of the regression model are listed in the Table 9 below, with significant variables denoted by asterisks. As expected *Amount* is negative and significant; the higher the fee amount, the less likely the respondent will say "yes". *Income, Water_Value, Education, D_Water_Recreation,* and *D_Hardy_River* were positive as expected. *No_Visits*, *Age*, and *D_Male* also turned out to be positive.

The variables that were significant at the 1% level are *Amount, Income, Water_Value,* and *D_Hardy_River*. This makes intuitive sense because we would expect that these variables represent some of the most important factors that would influence whether a respondent would be willing-to-pay the proposed fee amount.

Table 9. Logit Regression Results

Generalized R-Square= 0.2782

Parameter	Estimate
Intercept	-2.1322***
Amount	-0.0148***
Income	0.2606***
No_Visits	0.0917
Water_Value	0.3206***
Age	0.0167*
Education	0.0845
D_Water_Recreation	0.5159
D_male	0.3911**
D_Hardy_River	1.0475***

*** significant at 1%, ** significant at 5%, * significant at 10%

Median WTP

The median WTP among the sample is calculated using the formula developed by Hanneman described above. The median values for each of the independent variables are inputted in for the X values, and the parameter estimates shown above are the $\hat{s}$. Using this equation, it was calculated that the median WTP per entry per car is:

> $168 pesos (approximately $13 USD)[5] at sites along the Hardy River (Campo Mosqueda and Campo Baja Cucapah)
>
> $97 pesos (approximately $7 USD) at Morelos Dam, San Felipito, and the Cienega de Santa Clara.

Because there were two explicitly difference ranges of values used as the fee amount at the different sites, we need to make sure that this difference is accounted for. One method to account for the difference (as shown above) would be to create a dummy variable,

[5] MXN peso-USD dollar conversion as of 8/5/12.

D_Hardy_River. Another method would be to run two completely separate regressions. Luckily, we can use the Chow test to test whether the sample should be estimated in two separate models (the estimated βs differ between the two sub-samples) or whether the sample should be estimated as a whole with the dummy variable (the βs do not differ across the sample)[6].

Using the Chow test analog for the logistic regression, it was determined that the most appropriate model is the combined (or whole) model with the difference between the sites being accounted for by the dummy variable *D_Hardy_River*. The difference between the βs across the two groups was not statistically different from zero, therefore only one model should be estimated for the entire sample.

The model suggests that the median WTP of visitors to Campo Baja Cucapa and Campo Mosqeuda, along the Hardy River, is $168 pesos per entry. The WTP of visitors to Morelos Dam, San Felipito, and the Cienega de Santa Clara is $97 pesos per entry.

Conclusions and Policy Implications

The purpose of this paper was to understand the economic value of recreation in the Delta and the value that visitors place on a guaranteed source of water to support a healthy Delta ecosystem. Its goal is to contribute to Colorado River basin water management decisions by including the economic value of recreation and preservation of the Colorado River Delta. As such, this study addressed some fundamental questions regarding recreation and environmental

[6] The Chow test analog for the logistic regression, outlined by Allison (1999) and then again by DeMaris (2004), is given below.

Where = the fitted log-likelihood of the combined model, is the log-likelihood of the first group, and is the log-likelihood of the second group.

flows in the Colorado River Delta. We sought to understand who uses the Colorado River Delta as a place to recreate, the characteristics of people who would be willing to pay an entrance fee, and finally, the monetary value that visitors place on the recreational activities available and the protection of the Delta's ecosystems.

In terms of who is recreating in the Delta, a large majority of visitors traveling to the Delta are people coming from the local communities such as Mexicali, Los Algodones, San Luis Rio Colorado and their surrounding ejidos. The visitors range in age from 15 to 78 years old, with most visitors in the 20-40 year-old range. Visitors to Campo Baja Cucapah and Campo Mosqueda, along the Hardy River, represent a more affluent segment of visitors with a median annual household income of $81,000-$125,000 pesos whereas visitors to Morelos Dam, San Felipito, and the Cienega de Santa Clara have a median annual household income of $41,000-$80,000 pesos.

The significant factors contributing to the probability that a respondent would be willing to pay to guarantee a secure source of water to support a healthy Delta ecosystem include their income, the importance that they place on having enough water for ecosystems, their age, their gender, and whether the recreation site is along the Hardy River. The econometric analysis shows that respondents with higher incomes, greater environmental values, and those who are older and male are more likely to be willing-to-pay.

The results of this study suggest that recreational visitors to the Delta are willing-to-pay in order to guarantee adequate amounts of water to support and maintain a healthy Delta ecosystem, with just under 60% willing-to-pay the amount proposed to them. Visitors to Campo Baja Cucapa and Campo Mosqeuda, along the Hardy River, have a median WTP of $168 pesos

($13 USD) per entry. Visitors to Morelos Dam, San Felipito, and the Cienega de Santa Clara, on the other hand, have a median WTP of $97 pesos ($7 USD) per entry. Aggregate WTP values could be estimated if annual visitor numbers to these recreation sites were known. At the time of this study, this data was unavailable.

Understanding that visitors and local communities place economic value on the health of the Delta ecosystem and the resulting recreational benefits that it provides can assist policy makers when making difficult water allocation and management decisions. Furthermore, it is possible that a market mechanism could be designed in collaboration with these recreation sites where people are actually able to contribute to a fund to acquire a secure source of water. There is already a fund is existence, called the Delta Water Trust, where donations can be made to purchase water to support the Delta ecosystem. Portions of the entrance fees to Campo Baja Cucapah and Campo Mosqueda could be earmarked for water acquisition or ecosystem restoration.

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Appendix

Training Agenda

AGENDA
Delta Recreation Survey Training
March 29, 2012

Locations Surveyed:

Cienega de Santa Clara (CSC)
Campo Mosqueda (CM)
Campo Baja Cucapa (CBC)
Presa Morelos (PM)
San Felipito (SF)

Dates Administered:

The survey will be administered over the Holy Week weekend (April 6-9).

Supplies:

Surveys (5 different versions for each site)

- CSC-100 surveys
- CM- 200 surveys
- CBC- 200 surveys
- PM- 150 surveys
- SF- 100 surveys

Pens

Map of the Delta for EACH enumerator (needs to show the area defined as the Delta, as well as the locations of all sites, and the Colorado and Hardy Rivers)

Tally sheet for EACH enumerator for EACH day to mark the number of surveys completed and the number of non-participants.

Important Information about the Surveys:

Clothing sin logos/lemas.

Each survey will have a unique ID number in the top right hand corner. This ID number should be present on ALL pages of the survey. The ID number designates where the survey should be administered. CSC must be administered at the Cienega, CM at Campo Mosqueda, etc. It is very important that the survey is administered at the correct place because there are different versions of the survey.

Please encourage respondents to answer ALL questions and carefully record every answer. This is extremely important because if the question is not answered/recorded, the entire survey could potentially be thrown out of the study. Even information that doesn't seem important, like the date, please record it. It may be a variable in the analysis.

These questions have been carefully worded to avoid biasing the results, so please stick to the wording as closely as possible.

Visitor Contact:

At the beginning of each day, and at each site, begin a tally sheet. It needs to have your name, the date, the time you begin they surveys, the time you end, and the beginning and end numbers of the surveys conducted.

Approach all visitors over the age of 18. Multiple individuals from one party can respond to the survey.

Introduce the survey using the prompt given and ask if they would be willing to participate.
If no, thank them and discreetly note their response on the tally sheet. If yes, note the visitor's willingness to participate on the tally sheet. Make sure that the survey ID number matches the location of the survey.

Administer the survey, carefully recording the answers and encouraging the respondent to answer all questions. Possible wording, "We would be very grateful if you would complete the entire survey. We understand that you may be in the middle of your trip, but the answers can help us understand how these areas can better serve recreationists.

Thank the visitors for agreeing to participate and wish them an enjoyable trip.

Survey Questions:

1. For open ended questions, such as this one, we want to have every enumerator recording the answer in a consistent way. Ejidos should be designated as Ej. _____, colonias should be designated Col. _____, etc.
2. Make sure that the respondent is including themselves.
3. This question is designed specifically for large parties.
4. Please only fill out one of these sections. It is either a day trip or a multiple-day trip. It's important to note that the multiple-day trip refers to the number of *nights*, not the number of days. We want to capture the over-night visitors.
5. Please put a check mark or an "X" under the 1 column for the most important/main reason they came. Put a check mark or an "X" under the 2 column for the second reason. Please ONLY mark the top two, and be sure to rank them.
6. Don't forget to circle which measure of unit the respondent answered in. This is a free answer for the respondent, so they can literally answer anything. If they don't think there

is a minimum depth for the activities that they came to do, they are welcome to answer "0".

7. Please circle the response. Remember that someone else will be inputting the data into the computer, so please make it clear how the respondent answered.
8. Select only two reasons- do not need to rank.
9. If the person answers "a" to this question, you can skip to question #10. If not, please ask #9a-#9e.
    a. We are asking for averages here. If they do not remember, remind them that we are talking about all past visits and we want to know how long they stay on average.
    b. Please record in YYYY format. If they say, 10 years ago, clarify that they meant around 2002 and record that value.
    c. "Dry" at the Cienega means any shallow area that has dried out. It could be along the shore or it could be in areas that act as intermittent lagoons. "Dry" in the in the rivers means cracked earth (no water at all), or no flowing water (it can be muddy or have portions with standing water). If they have seen the site "dry", please record the year that they recall seeing it.
    d. Please mark all answers that apply. They are allowed to enjoy all activities if they want. Please specify if they have another activity that they enjoy doing.
10. Respondents can have multiple answers to this question. Poor water quality could be in terms of odor, clarity, cleanliness. If they have another reason, please specify.
11. We are trying to ask what other recreation sites that are "competing" with these sites. Ask the question first, and if they are having trouble coming up with an area then you can give the examples listed.
12. The next two questions are designed carefully to understand if people are aware of the Delta's importance. Follow the wording as shown on the survey.
13. Follow the wording on the survey.
14. Please make sure to explain that 1 is the most important, 5 is the least important and 3 is neutral. It's imperative that no one get confused about the scale.
15. Section 3 is the most important part of the survey. Please make sure to read the paragraphs in their entirety and follow the wording as closely as possible. The respondent has two choices: 1) they are willing to pay the amount for entry or 2) they prefer to not pay for entry.
16. For this question, the enumerator will read the question aloud and then hand the last sheet of the survey to the respondent to respond to the question. The last sheet is a payment card where the respondent can choose from a list of values for the maximum that they'd be willing to pay. Although the enumerator will read the question aloud to the respondents, please have the respondents mark the sheet themselves. Once the respondent has marked the sheet themselves, please record their response on the blank in #16.

If the respondent answered “0” for #16, they need to answer part 16a. Read from the selection of responses and have the respondent select the ONE reason that explains why they chose that value.

17. Complete the rest of the survey as indicated.
18. Record any comments or suggestions the respondent has.

Checklist

DELTA RECREATION SURVEY CHECKLIST

Did you remember to dress in a neutral manner and avoid wearing shirts with slogans?

Have you started the Tally Sheet?

Have you verified that the surveys you are about to administer are the correct survey for the location?

- Cienega de Santa Clara (CSC)
- Campo Mosqueda (CM)
- Campo Baja Cucapa (CBC)
- Presa Morelos (PM)
- San Felipito (SF)

Are you contacting all visitors over the age of 18?

Are you using the entry paragraph written for you and asking if they would be willing to participate?

- If they answer no, are you thanking them and discreetly noting their response on the tally sheet?
- If they answer yes, are you noting the visitor's willingness to participate on the tally sheet?

Administering surveys.

- Did you follow the wording of the survey as closely as possible?
- Did you read #16 to respondents and have them mark the payment card sheet (last page) themselves? Did you record the answer in the blank provided in #16?
- Did you carefully record ALL answers, making sure they are clearly marked?

Did you record ALL comments or suggestions made by the respondent?

Did you thank the visitors for agreeing to participate and wish them an enjoyable trip?

At the end of the day, did you complete the tally sheet?

Did you take note any problems or frequently asked questions? If so, please e-mail Ashley at akerna@email.arizona.edu.

Thank you for being a part of this project! We appreciate your hard work!

Tally Sheet

Delta Recreation Survey Tally Sheet

Location: _____

Name of Interviewer: _____ **Date:** _____

Time Started: _____ **Beginning Survey Number:** _____

Time Ended: _____ **Ending Survey Number:** _____

Participants	Non-Participants
(Sample entry: [redacted])	Refused (note reason if possible)