The following manuscript has been published in:

***The Law and Economics of the Environment*,**
2001, Anthony Heyes, Editor, pp. 319-367.

ENVIRONMENTAL DAMAGES IN COURT: THE *AMERICAN TRADER* CASE[1]

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1. INTRODUCTION

On February 7, 1990 the steam tanker *American Trader* spilled 416,598 gallons of crude oil approximately one and one-half miles off the coast of Huntington Beach, California. Almost eight years later, a ten-week trial in an Orange County state court came to an end on December 8, 1997 with a verdict for the plaintiffs in the amount of $18 million—the first jury verdict for natural resource damages ever delivered in the United States.[2] Economics, and economists, played a central role in the trial, occupying four weeks of the trial testimony. This paper describes the economic issues that were raised in the case and explains how they were treated, viewed from the plaintiffs' perspective. Because the *American Trader* case went to trial, unlike almost every other suit for natural resource damages including the one following the *Exxon Valdez* oil spill, the arguments of both sides and the analyses of their expert witnesses have been fully aired in public, making it possible to discuss this case in some detail.[3] [4]

"The polluter pays" principle is meaningful only if one can establish satisfactorily *how much* that should be. That was the main focus of the *American Trader* trial.[5] This case illustrates some of the issues that can arise in the course of implementing the liability approach to pollution control. More generally, it illustrates the issues that can arise when one applies economic analysis in litigation. There was no disagreement in this case regarding the appropriate economic methodology; all of the argument was about the empirical implementation of economic methodology. Consequently, issues relating to data collection, analysis and interpretation were at the heart of trial. This is a perspective which is sometimes lacking in the theoretical literature on the liability approach to pollution control.

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[1]This is a revised and substantially expanded version of Chapman, Hanemann, and Ruud (1998). We are grateful to the State of California's attorneys, Sylvia Cano Hale, Deputy Attorney General, and Michael Leslie, Mary Newcombe and David Pettit of Caldwell, Leslie, Newcombe and Pettit, for their assistance in providing information; it was a pleasure to work with them throughout the course of this litigation.

[2]People of the State of California ex rel. Department of Fish and Game, et al. v. BP America, Inc., et al., Orange County Superior Court Case Number 64 63 39; the authors were testifying experts for the plaintiffs.

[3]Dunford (1999) and Kolstad and Deacon (2000) discuss this same case from a defendant's perspective. Some other natural resource damage cases have been discussed in Mead and Sorenson (1970), Brown et al. (1983), Kopp and Smith (1990), and Ward and Duffield (1992).

[4]In the case of the *Exxon Valdez* oil spill, the state and federal governments negotiated a settlement with Exxon in 1991 before they had completed their natural resource damage assessments. The cases that did go to trial involved claims by commercial fishermen for private economic losses. Cases by Alaskan natives for loss of subsistence use of fish and wildlife were settled just prior to trial; the court refused to allow other private claims for economic loss and for loss of recreational use and enjoyment (Duffield, 1997).

[5]ATTRANSCO, the sole defendant in the 1997 trial, had already accepted responsibility for the spill. The other issues being tried were the amount of oil (the State is allowed to impose a civil liability not to exceed $20 per gallon spilled) and whether or not the defendant was negligent because its employees had not taken sufficient steps to avert the accident, which would expose ATTRANSCO to claims from the other defendants who had already settled.

The *American Trader* was carrying approximately 23,100,000 gallons of oil on the afternoon of February 7th, 1990 when it approached the offshore sea berth of the Golden West refinery in Huntington Beach. The oil came from Alaska, had been shipped to Los Angeles where it was transferred to a smaller tanker, and was being taken for final delivery to the Golden West refinery. The captain was relatively unfamiliar with the refinery, there was a low tide, and as the ship attempted the difficult maneuver into the offshore mooring, which involves using its anchors as pivot points, it hit and punctured the hull and the front right storage tank with its own anchor.[6] The crew members had left valves open connecting this tank to two adjacent storage tanks, and their contents also flowed into the ocean.

Offshore winds kept the oil at sea for several days, but then it came ashore. Approximately 14 miles of beaches were closed for a period of up to 34 days from Alamitos Bay in Los Angeles County to Crystal Cove State Beach in Orange County. The affected beaches were reopened in stages as the cleanup progressed, with the last beaches re-opening on March 14. To protect fragile wetland areas, Newport Harbor, Huntington Harbor, Alamitos Bay and the mouth of the Santa Ana River were boomed off to prevent oil from entering the harbors. In addition, a large portion of the Huntington Flats fishing area, off the coast of Huntington Beach, was closed to boating and fishing for about two weeks.

On February 8, the State of California contacted Hanemann and asked him to conduct an economic analysis of the natural resource damages caused by the spill.[7] On February 9, Chapman, who had been born and raised in the Los Angeles area and was then a graduate student in the Department of Agricultural & Resource Economics at UC Berkeley, went down to Huntington beach to start collecting data. By the time of trial, the State's economic team had grown to include Paul Ruud[8], Roger Tourangeau[9], Stanley Presser[10] and Michael Ward[11]. Pierre Du Vair, staff economist in the Office of Oil Spill Prevention and Response (OSPR) of the California Department of Fish and Game (DFG) served as that agency's project manager for the economic component of the damage assessment.

This paper is organized as follows. The next section provides an overview of the case and the events preceding the trial. The economic research performed for the State can be divided into two phases. The first phase of the research was performed with the expectation of a negotiated settlement; this work is described in Section 3. The defendants' responses to it are described in Section 4. The second phase of our work began when it became apparent that the case would go to trial; this work is described in Section 5.

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[6]Testimony revealed that the ship's pilot thought he was in 56 feet of water, when he was actually in 50 feet.
[7]Also on February 8, ATTRANSCO signed a contract with RTI to conduct an economic damage assessment.
[8]Paul Ruud is a Professor in the Department of Economics at the University of California, Berkeley.
[9]At the time of the assessment, Roger Tourangeau was a survey research expert at the National Opinion Research Center; he has since joined the University of Michigan's Survey Research Center where he is a Senior Scientist.
[10]Stanley Presser is Director of the Survey Research Center and Professor of Sociology at the University of Maryland, College Park.
[11]Michael Ward is an Assistant Professor in the Department of Agricultural and Resource Economics at the University of California, Berkeley.

The trial is described in Section 6. Section 7 offers some concluding observations about presenting economic analysis in court.

2. OVERVIEW OF THE CASE

At the time of the spill, there existed various state and federal statutes allowing for natural resource trustees to make damage claims for injury to, loss of, or loss of use of, natural resources. The main federal statutes were the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), the Federal Water Pollution Control Act (Clean Water Act), and the Trans-Alaska Pipeline Authorization Act (TAPAA). The Oil Pollution Act of 1990 (OPA), written in part as a response to the EXXON VALDEZ oil spill, was not signed into law until August of 1990. For the State of California, the primary authorizing statute at the time of the spill was section 294 of the Harbors and Navigation Code. Subsequent to the spill, the State of California enacted the Lempert-Keane Act, which is now the primary oil spill legislation in the state.

Under all of these statutes, a damage claim consists of three components: the cost of projects to restore injured natural resources, compensation for the loss of services from the affected resources during the period when they are injured, and the cost of conducting the damage assessment. The work done by the authors focused on the second category: the value of lost recreational use. This was the focus of the economic portion of the trial.

The State's strategy was determined early in the assessment process through discussion between the NRDA team and the Trustees -- the California Departments of Fish & Game and Parks & Recreation, the State Coastal Conservancy, the Regional Water Quality Control Board, the State Lands Commission, NOAA, and the U.S. Department of the Interior. It was decided to separate the assessment of injuries to biological resources[12] from the lost recreational use. Also, to keep the costs down, it was decided to use the benefits transfer approach to obtain an estimate of recreation use damages.

As with many other natural resource damage cases, multiple responsible parties were involved in the *American Trader* case. The tanker was owned and operated by ATTRANSCO, and was under charter to British Petroleum Shipping Company. BP Oil Supply Company was the title owner of the oil cargo, and Golden West Refining was the owner and operator of the sea berth. Since the oil came from Alaska, another entity involved as a defendant in a separate legal proceeding in federal court was the Trans-Alaska Pipeline Liability Fund, created by Congress to provide compensation for any losses sustained as a result of a spill of oil from the Trans-Alaska Pipeline system (TAPS).

The initial presumption was that the case would be settled through negotiation, without going to trial. This had happened with previous natural resource damage suits brought by the State of

[12]After the spill, 595 oiled birds were recovered dead or died at cleaning centers, including 79 brown pelicans, an endangered species. Allowing for unobserved bird injuries and deaths, it is estimated that a total of 5,390 birds were oiled, of which 2,544 died. In addition there was some death of finfish and shoreline organisms, but no marine mammal deaths.

California. For example, litigation following an oil spill in San Francisco Bay in March 1988 at the Shell Oil refinery at Martinez had been settled within less than a year.[13] Trials are expensive and fraught with uncertainty. As one of the attorneys said to us, "you only go to trial when there is a breakdown in rationality."

Negotiations with the various parties commenced very soon after the spill. At the same time, work proceeded on a preliminary damage assessment. The first settlement was with British Petroleum in 1993; BP agreed to pay a total $3,894,247 for bird restoration, fish hatchery projects, coastal pollution mitigation projects, agency revenue losses and response costs. In 1994, faced with a lack of progress in negotiations with the other parties, it was decided to revise and expand the damage assessment, and Paul Ruud was added to the State's economic team. Ruud and Hanemann produced written expert reports in December 1994. At about this time, following a presentation by the State's team to the TAPS economic consultants, a $3 million settlement was reached with the TAPS Fund to be applied towards clean-up costs and loss of use damages.

This left Golden West and ATTRANSCO as the remaining defendants. Golden West's economic experts were Professors Robert Deacon and Charles Kolstad from the Economics Department at UC. Santa Barbara, and they issued a written review of the State's economic analysis in March 1995.[14] ATTRANSCO's economic experts were Triangle Economic Research (TER) – economists formerly employed by the Research Triangle Institute (RTI)—led by Dr. Richard Dunford. TER brought in Professor Walter Thurman from the Department of Agricultural and Resource Economics at North Carolina State University to review and rebut Paul Ruud's analysis; TER and Thurman issued written reports in May 1995.[15]

By the end of 1995, it appeared likely that, while there would be a settlement with Golden West, ATTRANSCO would not settle. In January 1996, therefore, the State began preparing for a trial on the economic issues. The settlement with Golden West was finalized in July 1996, in the amount of $4.15 million; this left ATTRANSCO as the only defendant in the case.[16] The sole remaining claims at the trial were the Trustee's claims for lost recreational use and civil liabilities under the California Water Code. In preparation for the trial, Hanemann, Ruud, and Thurman issued supplementary written reports, and depositions of economic experts were held in September, November, and December 1996. Another round of depositions was held in August 1997, and Hanemann issued a final expert report. Overall, between 1996 and 1997, there were more than twenty days of deposition and a filing cabinet's worth of documents exchanged among the parties. The trial commenced on September 30, 1997 and ended with the jury's verdict on December 8, 1997.

At the trial, losses to six recreational activities were presented: (1) general beach use, (2) surfing, (3) private boating, (4) party/charter boat fishing, (5) whale watching, and (6) excursions to Catalina Island off the coast of Los Angeles. From discussions with local officials and user groups,

[13]For an account of this case, see Hanemann (1992).
[14]Their analysis was subsequently described in Kolstad and Deacon (2000).
[15]Their analysis was subsequently described in Dunford (1999).
[16]Before the trial, ATTRANSCO offered to settle for $2.5 million; the State asked for $5.5 million, and the negotiations were inconclusive.

we knew that other recreational activities occur in the area and were likely to have been affected by the spill, including wildlife viewing, running, rollerblading, hiking, and bicycling. But, lack of readily available data led to a decision to exclude those activities from the State's claim. Also, there was no claim for losses of non-use value associated with the spill.

This paper focuses on our assessment of the impacts on general beach recreation and surfing, which constituted the bulk of the State's recreation claim. The economic issues that arose in that analysis are the subject of the sections that follow.

3. THE FIRST ROUND OF ECONOMIC ANALYSIS

The beaches affected by the spill provide a high quality recreational experience to users from many parts of the Southern California Basin. For the population of Orange County and the southern part of Los Angeles County these are the beaches and harbors of choice. Other beaches in Santa Monica Bay would generally be considered too far to drive to. In addition, many of the affected beaches are excellent surfing locations --in fact, Huntington Beach is known as "Surf City" and is enshrined in popular culture as the center of the Southern California beach lifestyle. While only a fraction of the population engages in surfing, this adds an aura of glamour, which many visitors find attractive. Besides surfing, many of the beaches in the area affected by the spill offer a wider and more attractive mix of recreational opportunities than some of the beaches in Santa Monica Bay. Beaches in Santa Monica Bay tend to offer open expanses of sand but few other facilities. By contrast, at the beaches affected by the spill, in addition to large expanses of sand, there are boardwalks, piers, shops, and other attractions for visitors and tourists, combined with excellent access and ample parking.

The use of the affected beaches is highly seasonal – it climbs as the weather grows warmer and summer arrives, and falls as winter approaches. But, even in the winter, there is still a considerable attendance. At the time of the spill, for example, Newport Beach, the largest of the affected beaches, had an average daily attendance of about 5,000 persons/day in January, 10,000 in February, 15,000 in March, 22,000 in April and May, 40,000 in June, 65,000 in July and August, 22,000 in September, and 5,000 in October, November and December. The spill kept parts of Newport Beach closed from February 8 through March 9. Had it occurred during the summer, the loss of beach recreation would have been tremendous.

From the beginning, the State decided to rely primarily on existing data. Because of lack of time and personnel (there were only two of us, working part-time, with only one of us on the scene in Orange County), because of the limited budget, and because of the expectation of a negotiated settlement, it was decided not to attempt any large-scale collection of original data such as a travel cost survey.[17]The other factor that entered into this decision was our knowledge that there existed

[17]The National Marine Fishery Service (NMFS) had just decided in January 1990 to discontinue its bi-monthly telephone survey of households in coastal counties along the West Coast to measure participation in saltwater fishing. The State agreed to fund one more wave of this survey, covering January-February 1990, with a slightly expanded questionnaire that covered saltwater boating as well as fishing. However, the NMFS survey did not contain valuation questions.

unusually extensive data on daily attendance at most of the affected beaches covering a period of years prior to the spill. We decided to rely on these data to develop an estimate of the lost beach recreation attributable to the spill, and to use benefits transfer for an estimate of the lost consumers' surplus per trip.

With refinements, this remained our strategy from the initial assessment after the spill up to the trial. In implementing it, we had to deal with six major issues: compiling and verifying the attendance data; developing a statistical model to forecast attendance in the absence of the spill; adjusting for attendance recorded at beaches while they were closed; dealing with the issue of substitution to other beaches that remained open; allowing for the possible impact on attendance after re-opening; and selecting an estimate of consumers' surplus from the literature.

Compiling Attendance Data

The attendance data was the backbone of our analysis. At each of the main affected beaches, the lifeguards make a serious effort to record daily attendance. In our experience, these data are more extensive than what one usually finds in most other parts of the United Sates, including in Northern California. However, since they are collected for administrative and management purposes, including scheduling lifeguard staffing and budgetary planning, they are estimates and not a scientific census of beach attendance.

Different procedures are used at different beaches. Three of the affected beaches Bolsa Chica, Huntington State, and Crystal Cove -- are state beaches run by the California Department of Parks & Recreation. These beaches have paid parking lots at the beach and are designed so that people coming to the beach are funneled through a small number of checkpoints. Typically, there are 3 or 4 pedestrian and vehicle entrances, roughly one per mile of beach length. During the winter, however, all but one of these entrances is usually closed to vehicle traffic. The remaining entrance is manned during most of the daylight hours for the purpose of collecting the entrance fee.[18] However, vehicles on official business do not have to pay the entrance fee. All vehicles entering the park, whether or not they pay the fee are counted, and these counts form the basis for the official estimate of daily beach attendance. Two conversion factors are used in this calculation: an estimate of the number of people per vehicle, and an estimate of the ratio of "walk-on" beach users to users entering in a vehicle. These factors are based on observations by the lifeguards, and are periodically revised. They can vary seasonally and, sometimes, from one month to another; they also can vary across beaches. Typically, the DPR lifeguards might use 3.5 or 4 persons per paid vehicle, and a ratio of 1:1 for walk-ons versus drive-ins. There are also separate calculations for organized groups and, at Bolsa Chica, for overnight parking by campers.

The other two main affected beaches are operated by the cities of Huntington Beach and Newport Beach. The Huntington Beach lifeguards base their estimate of beach attendance on monitored parking at two parking lots by the beach, extrapolated to cover other, unmonitored, city-operated parking, and then adjusted by a factor to account for night-time beach attendance and

[18]At the time of the spill, this was $4 per vehicle or $50 for an annual pass.

daytime beach attendance at two more distant parts of the beach. At Newport Beach, the reports are based on estimates of attendance by the lifeguards at various points along the beach, updated several times during the day; these estimates generally are rounded numbers (e.g., 1,000, 2,500, 25,000).

In addition to the affected beaches, we also collected daily attendance data for Laguna Beach, a beach four miles south of Crystal Cove that remained open throughout the spill. This beach is operated by the City of Laguna Beach, and the lifeguards there make estimates of attendance in a manner similar to Newport Beach.[19]

In addition to compiling the data, we made a concerted effort to understand how they were collected. This was rather like peeling the layers off an onion. At the state beaches, it turned out that there are several levels of reporting. First, the lifeguards at the parking booth keep a contemporaneous handwritten record of receipts and a count of free vehicles. Then, every few days, they fill out a typed Report of Collections form, detailing receipts from paid vehicles. The information on daily paying and free vehicles is also entered on a handwritten Monthly Visitor Attendance Report, which has a row for each day of the month and columns for the number of paying and free vehicles and campers. At the end of the month, this form is forwarded to DPR Headquarters in Sacramento, where the data is keypunched to generate a computerized version of the Monthly Visitor Attendance Report. It is the monthly total attendance figures that appear in publicly available reports issued by DPR. To get at the daily data, we obtained photocopies of the handwritten Monthly Visitor Attendance Reports from the local DPR office. In 1990, what was available of these forms went back to around 1985. The appropriate multipliers for that month were not usually listed in the form and, while the forms contained the elements that go into the calculation of total daily attendance, the total itself was usually not filled in. The computer-generated version of the Monthly Visitor Attendance Reports at DPR headquarters does contain the multipliers and the calculated total daily attendance, but we did not learn of the existence of microfiche copies of these reports in DPR headquarters until August 1994. For our analysis prior to that time, we had been compelled to figure out for ourselves the calculations that were supposed to be performed, keypunch all the raw data, program the calculations, and then compare the results with the published monthly attendance data. When there were occasional discrepancies, we had to try to guess the cause; sometimes, for example, this was due to data being entered in the wrong column on the handwritten form. Once we obtained the microfiches of the computer-generated forms, we switched to using the daily attendance totals recorded in those forms as the official DPR estimate of attendance.

[19]It was not possible to obtain data on daily attendance at other beaches near the spill area. The next two beaches south of Laguna Beach, Aliso Creek Beach and Salt Creek Beach, are both operated by the Orange County Recreation Department which reports attendance on a monthly but not a daily basis. At Doheny State Beach, daily attendance data might have been available but we thought this would not be useful because the main parking lot at Doheny was closed for repair at the time of the spill, which significantly affected recorded attendance. The two closest beaches to the north of Bolsa Chica are Sunset Beach and Surfside Beach; both are small beaches and no attendance records are kept for them. Part of Seal Beach was closed for two days following the spill. The lifeguards at Seal Breach had kept a record of daily attendance from 1985 through 1987, but had discontinued this from 1988 onwards. The next beaches to the north are in Los Angeles County, starting with Belmont Shores; there were monthly but not daily attendance data for the beaches in Los Angeles County.

Because of the pronounced difference between winter and summer beach attendance, we decided at a very early stage to focus our efforts on modeling daily attendance at the affected beaches during winter months only -- we felt that it would only confound the analysis if we were to combine summer with winter months. This also reduced the amount of data that we would need to collect. Beach attendance generally begins to pick up around the Easter break at local schools. We therefore decided to focus on daily attendance during the period December - March. To have a comparable data set for all beaches, we started our analysis with the winter of 1986 (December 1985 - March 1986). Our data set eventually covered 8 winters, four months per winter, from 1986 through 1993.[20]

Modeling Attendance

Paul Ruud estimated a vector-autoregressive model consisting of separate equations for daily attendance at each of the 6 beaches for which we had collected data (Ruud, 1994).[21] The explanatory variables included rain at the beaches, maximum and minimum daily temperature inland, dummy variables for holidays and weekends, annual dummies, linear and nonlinear time trends within the winter season, and lagged values of attendance of the beach in question and at neighboring beaches. The lagged variables captured the empirical fact that high attendance at a beach one day is usually followed by high attendance there on the next day; but, because of some substitution among beaches, high attendance at one beach might be followed by low attendance the next day at a neighboring beach. Because of the clear presence of heteroscedasticity, the model was formulated as an exponential regression equation with an additive normal error, fitted by nonlinear least squares. This allowed the explanatory variables to influence the variance as well as the mean of the logarithm of daily attendance. The model fitted the data well and closely tracked fluctuations in attendance on both normal weather days and unusually cold or wet days.

The fitted model was used to predict the daily attendance that would have occurred during the period February 8 - March 31, 1990 in the absence of an oil spill at each of the beaches that were closed. This prediction is summarized in the first two rows of Table 1, in the column labeled "Predicted Attendance."[22]

Adjustments to Attendance Recorded During the Closure Period

The loss of beach recreation was taken to be the difference between the number of beach recreation trips that *would have* occurred at a site from February 8, 1990 onward, as predicted by our model, and the number of beach recreation trips that *did* occur there.

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[20]When estimating his model, Ruud did not use the data from February 7 through March 31, 1990.

[21] These are the five beaches closed due to the spill – Bolsa Chica, Huntington and Crystal Cove State Beaches, and the city beaches of Huntington Beach and Newport Beach – together with Laguna Beach.

[22]In Table 1, the "closure period" refers to the dates when the beaches were partially or completely closed. At Newport Beach, the first part of the beach re-opened on February 19 and 20, other parts re-opened on February 28, and the remainder re-opened on March 10. At Huntington City Beach, part re-opened on March 1, and the remainder on March 14. Part of Bolsa Chica and Huntington State Beaches re-opened on March 2 and March 3, the remainder re-opening on March 14. "Outside the closure period" refers to any days during the period February 8 - March 31, 1990 when the particular beach was fully open.

Determining the latter was non-trivial, however, because even when the beaches were closed, some cars were parked in places that lifeguards normally counted, and these were counted in the usual manner regardless of whether or not the occupants were engaged in anything resembling normal beach recreation. The lifeguards continued to count in the usual manner when beaches partially re-opened, with cleanup operations continuing in closed-off portions of the beach. From what lifeguards subsequently told us, it was evident that some of the people being counted were working on the spill or were coming as onlookers to view the cleanup. Vehicles recorded as free vehicles at the state beaches included volunteers coming to work on bird rescue, people delivering supplies for bird rescue and oil spill cleanup, and state and local agency personnel working on spill response and cleanup. At Huntington State Beach, for example, 12,858 free vehicles were recorded in March 1990, compared to an average of 2,062 free vehicles in March of 1986, 1987, 1988, 1989 and 1991. We assumed that people associated with the unusual increase in free vehicles were not engaged in beach recreation. There was also an unusually large number of paid vehicles using annual passes. From our conversations with lifeguards, we believe that some of these were volunteers coming to work on bird rescue and others were locals coming to the parking area to check things out, but not necessarily to engage in beach recreation.[23] At Huntington State, annual passes accounted for 65% of paid vehicles in March 1990, compared to 22% in February 1990 before the spill, and 25% in March 1991.[24] We assumed that the excess over 25% of paid vehicles represented people not engaged in beach recreation. We made similar adjustments at Bolsa Chica for excess free vehicles and paid vehicles using annual passes.

At Newport Beach, a different adjustment was required. Unlike state beaches where public access is restricted to three or four entry points, there is public access to the city beaches from anywhere along the boardwalk running parallel to the beach. In their attendance estimates, the lifeguards at Newport Beach aim to record the number of people they are responsible for guarding and protecting, not just beach recreation per se; therefore, they count anybody in the general vicinity of the beach. Normally these are people engaged in beach recreation; during the spill, this also included cleanup workers, local officials, members of the press, and onlookers standing around the boardwalk watching the cleanup. Hence the Newport Beach attendance data after February 7 include many people who were not engaged in beach recreation, but there was no way of telling how many from the data itself. We knew what fraction of the beach was open each day, and we decided to use this fraction multiplied by our prediction of what beach recreation would have been in the absence of the spill as our estimate of the beach recreation that did occur during the period of beach closure.[25]

Our modifications of the officially recorded attendance are reflected in the first two rows of Table 1 in the column labeled "Adjusted Attendance." The lifeguards reviewed these estimates and concurred with them. We felt that, while they were based on rough judgment and were not precise estimates, they reflected the best information available to us.

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[23]A story in the *Los Angeles Times* on March 3, 1990 noted the "throngs of curiosity-seekers who flocked to the area to see the effects of the spill."

[24]This breakdown comes from the Report of Collection forms; these forms were no longer available for the years prior to 1990.

[25]Even when the whole beach was roped off, there was access to a small portion immediately adjacent to the boardwalk, representing about 5% of the beach area.

Substitution

An issue to which we paid particular attention was the possibility of substitution that could offset the loss of recreation at the beaches affected by the oil spill. This could take the form of *spatial* substitution, whereby trips were diverted from beaches that were closed to other beaches in the Los Angeles area, or *temporal* substitution, whereby trips lost at the time of the spill were merely postponed to a later date. However, after carefully examining the available information, we reached the conclusion that there was probably *no* overall substitution, in the sense of a net increase in aggregate attendance either at other beaches outside the spill area or at the spill area beaches after they re-opened.

This conclusion was based on several pieces of evidence. If there had been any substantial spatial substitution, Laguna Beach was an obvious candidate since it was the closest unaffected beach to the south. However, the data there showed an overall *decline* in visitation of approximately 23% compared to what we predicted in the absence of an oil spill. We also found no evidence of an increase in attendance when we looked at other beaches further south, including Aliso Creek Beach, Salt Creek Beach and Doheny State Beach. Similarly, when we looked at four beaches to the north of the spill areas in Santa Monica Bay --Redondo, Hermosa, Manhattan and Dockweiler Beaches -- and compared monthly attendance at these beaches in February and March 1990 with attendance in February and March of 1988 and 1989, we found that, if anything, there was a decrease in 1990. This was consistent with something we had been told by lifeguards at one of these beaches, namely that they had received phone calls at the time of the spill from people asking whether it was safe to go to these beaches because of the oil spill. There certainly may have been spatial substitution by some people who used beaches closed due to the spill. But, it was apparent that the oil spill had cast a pall on beach recreation through the entire region. Extra visitation of the beaches that remained open by people substituting away from the closed beaches could have been more than offset by a reduction in visitation by people who normally used these other beaches but were staying away because of concerns fueled by the extensive media coverage of the spill.

With regard to temporal substitution, the data do show a net increase in visitation at two beaches, Bolsa Chica State Beach and Huntington State Beach after they had re-opened (March 14-31, 1990).[26] At the other three beaches, however, while there were unusually large crowds on the weekend after the re-opening, attendance after that was depressed through the end of the month compared to what our model predicted in the absence of a spill. This was consistent with the lifeguards' impression that the initial turnout after re-opening represented widespread curiosity about what the beaches were like, but then lingering concerns kept some people away. Even including the unusually large attendance immediately following re-opening, there was an overall *reduction* in aggregate visitation at the five beaches combined between re-opening and March 31, 1990. We suspected that attendance at some of the affected beaches remained depressed into April, but we were not in a position to measure this since Ruud's model was not designed to predict beach

[26] At both of these beaches we adjusted the attendance reported after re-opening to correct for an excess number of free vehicles but we did not correct for an excess number of paid vehicles with annual passes. Some of the latter were coming just to see what the beach looked like after re-opening rather than to engage in beach recreation, but we included them in the total of beach users anyway.

attendance in April.

Estimated Loss of Beach Recreation

Using the assumptions described above, our estimate of lost beach recreation in the oil spill area during the period of beach closure amounted to 454,281 lost trips. Overall, we estimated a net loss of 278,986 trips outside the beach closure period through March 31, 1990. While we believed there might have been some net loss of beach recreation in April, we could not measure this and did not include it in our estimate.

In addition, we believed that this estimate of lost beach recreation omitted some loss to surfing recreation that was not being captured in the official reports of beach attendance. Surfers often go to the beach very early in the morning, and they generally try to avoid paid parking. On both grounds, they are likely to be undercounted when reported beach attendance is based on counts of cars using paid parking lots. By interviewing surfers, surf shop operators and lifeguards, we developed estimates of the number of surfers per weekday and weekend day at various surfing locations in the affected area who might be excluded from the official reports of beach attendance. Applying this to the beach closure period (but not the period after re-opening), we estimated an additional loss of about 30,485 surfing trips, producing an estimated total loss of 763,752 beach recreation trips, as indicated in the top panel of Table 1.

Unit Values

To convert this estimated loss of recreation into a monetary value, we reviewed the existing literature to find an appropriate unit value of beach recreation. When performing this analysis in 1994, we were aware of only a few travel cost studies that provided estimates of consumers' surplus for beach recreation. Of the studies listed in Table 2, we were aware at the time of Binkley and Hanemann (1978), Meta Systems (1985), Bockstael, McConnell and Strand (1988), McConnell (1977), and McConnell (1992). However, those studies all valued beach recreation in the Northeast, which we felt was likely to be different from beach recreation in Orange County because "both the economic and social situation are different. Orange County offers high quality beaches close to – even immediately adjacent to - where people live. In the Boston area, there are beaches in Boston Harbor which are located close to where people live, but these are decidedly not high quality beaches. The high quality beaches tend to be quite distant, around Cape Cod. In economic terms, the price associated with high quality beach recreation is very different in Orange County than Boston. Partly because of this, and partly because of the climate, beaches play a different role in social life in the two regions. There are good reasons why the phrase "beach boy" is associated with California rather than Massachusetts" (Hanemann, 1994).

Aside from the Northeast beach studies, we were aware of two travel cost studies on beach recreation, one for California by Dornbusch (1987) and the other for Florida by Bell and Leeworthy (1986). Both were well known and often cited in the literature.[27] Although the study by Dornbusch

[27]In a natural resource damage assessment for another Southern California oil spill, at Avila Beach in 1992, Dunford had used the corresponding regional value of beach recreation from Dornbusch (1987) amounting to $12.08 per trip

would seem an excellent candidate for a benefits transfer exercise since it provides estimates of the consumers' surplus associated with water-dependent and water-enhanced recreation at beaches along the entire California coast, including Orange County, we felt that it had a serious flaw which rendered it unreliable. The Dornbusch model was estimated from survey data on beach trips by California residents. Although this was not widely appreciated at the time, the survey only asked respondents how many beach trips they took; it did not ask where they went. Analysts in DPR subsequently used a gravity model to allocate the trips among alternative destinations, and these "home-made" origin-destination data were then provided to Dornbusch to analyze, as though these were real observations on destination choice behavior. We felt this was, at best, a circular exercise.

No such problems were apparent in the study by Bell and Leeworthy (1986), based on a statewide survey of Florida residents in March 1984 covering their beach use during the previous 12 months. Bell and Leeworthy estimated a demand function for days at Florida beaches, from which they derived an estimate of consumer's surplus of $10.23 per person-day, in 1984 dollars.[28] We felt that beach recreation plays a similar role in people's lives in Southern California as in Florida. The average household income of the respondents to the Florida residents survey in 1984 was $26,871, compared to a median income of about $37,600 in Orange County in 1985; if anything, this should make Bell and Leeworthy's figure a conservative estimate of the consumers' surplus for beach recreation in Orange County. We used the Consumer Price Index for urban consumers in the Los Angeles-Anaheim-Riverside area to convert their estimate to February 1990 dollars, the time of the spill, which raised it to $13.19 per trip.

While surfing is a specialized recreation activity which would generally be considered to have a higher unit value than general beach recreation – see, for example, Walsh et al. (1998) – we knew of no valuation study that dealt specifically with surfing. We decided to use a unit value of $16.95 per surfing trip. This corresponded to the entrance fee at an inland water park in Southern California; the amount was suggested to us by an official of the Surfrider Foundation, who thought most surfers experienced a consumers' surplus at least equal to this, and it represented a premium of about 30% over our estimate of the unit value of general beach recreation.[29]

Our resulting estimate of the value of the lost beach and surfing trips totaled $10,188,500, in 1990 dollars, as indicated in Table 3.

Besides beach recreation and surfing, our 1994 analysis covered private boating and party/charter boating for sport fishing, whale watching, and excursions to Catalina Island. Combined, these amounted to about 31,000 trips.[30] Using benefits transfer estimates of consumers' surplus for boating and sport fishing, we estimated a total loss of $1,231,609 for these categories of recreation.

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in March 1993 dollars (Dunford, Banzhaf and Mathews, 1993).

[28]Bell and Leeworthy also collected data on recreation by non-residents at Florida beaches, from which they estimated a non-resident demand function and calculated consumers' surplus for a non-resident trip. We had no data which would allow us to break down lost beach recreation by residents versus non-residents of Southern California.

[29]In his Avila Beach analysis, Dunford had used a premium of 20% to value nude beach use, viewed as a specialized activity, and he had valued windsurfing at $16.91 in March 1993 dollars.

[30]These boating and fishing trips were lost when booms to keep the oil out blocked harbor entrances.

Thus, the total estimate in our 1994 report for lost recreation use value amounted to $11,420,108, as indicated in the top panel of Table 3.

4. THE RESPONSE FROM THE DEFENDANTS

In response to our 1994 reports, economists for two of the defendants produced reports critiquing our analysis -- Professors Deacon and Kolstad wrote a report in March 1995 on behalf of the Golden West refinery, and Professor Thurman and Dr. Dunford wrote reports in May 1995 on behalf of ATTRANSCO.[31] These reports covered fairly similar ground, disputing both our estimate of lost recreation trips and the consumers' surplus estimates we used for benefits transfer.

Disputing the Estimate of Lost Beach Use

With respect to the estimate of the number of beach trips lost as a result of the oil spill, the defendants raised five issues. First, there were criticisms of our data: the lifeguards' reports of beach attendance seemed unreliable. The defendants questioned both the methods by which attendance was estimated and the specific conversion factors used for passengers per vehicle, and walk-ons as a proportion of drive-ins.[32] Professors Deacon and Kolstad indicated that they intended to conduct overflights of beaches to verify the lifeguards' reports of attendance.

Second, the defendants criticized the adjustments we made to reported attendance during the period when beaches were partially re-opened and cleanup was still proceeding. Without offering any estimates of their own, they asserted that our adjustments lacked foundation. Moreover, Dr. Dunford argued that the oil spill and cleanup activities provided a positive consumers' surplus to "rubberneckers" which should be counted as an offset to some of the lost consumers' surplus from beach recreation.[33] He also proposed two other adjustments. First, he noted that some beach recreation in Southern California was by foreigners and/or illegal immigrants. On legal grounds, ATTRANSCO's attorney held that this should not be counted in a damage assessment; Dunford felt we should have made an effort to estimate this beach use and omit it from our calculation of lost recreation. Second, he took the position that "children should be excluded from estimates of foregone user days when calculating natural resource damages" on the grounds that they "do not understand the concepts of prices and income constraints."

Third, the defendants challenged our conclusion that there was no net substitution of recreation to beaches elsewhere in the region. They found our lack of evidence for an increase in attendance at Laguna Beach and at beaches in Santa Monica Bay unpersuasive. On theoretical grounds they felt that substitution must have occurred since there were many other beaches in Orange County and Los Angeles County that remained open during the spill and could have been used as substitutes "given

[31]Deacon and Kolstad (1995); Thurman (1995); Dunford et al. (1995).

[32]Dunford et al. (1995) made no reference to the fact that RTI had interviewed the very same lifeguards and collected the same attendance data from them in 1990 and 1991. Instead, the report professed to be baffled by the lifeguards' data and to have no independent knowledge of this beyond what was contained in our 1994 report.

[33]To implement this, he assumed that the consumer' surplus from rubbernecking lay between one-third and one-half of the consumers' surplus from beach recreation. See Dunford et al. (1997) for an elaboration of his arguments and Randall (1997) for an opposite view.

southern Californians' well-known penchant for driving long-distances to work and recreate."[34] Beyond the general argument, however, they presented no specific empirical evidence that significant substitution had occurred.

Fourth, they took the position that there could be no loss of recreation once the affected beaches had fully re-opened; their estimate of loss was confined to the closure period.[35]

Fifth, Professor Thurman and Dr. Dunford criticized Ruud's (1994) econometric model of beach attendance. They suggested that different weather variables should have been used, such as temperature at the beach as opposed to temperature inland. They claimed that the weather during the closure period in 1990 was unusually cold and "Ruud's model does not produce predictions that are consistent with the low temperatures." They also objected to his use of lagged dependent variables because actual lagged attendance could not be known when forecasting attendance during the spill period, and the use of a prediction of lagged attendance would lead to a compounding of the errors in attendance predictions. Using our data on attendance, which we had turned over along with the expert reports in 1994, Thurman (1995) estimated his own model of attendance at the 5 beaches affected by the spill, and he obtained a much lower prediction of what attendance would have been during the closure period in the absence of a spill – 297,992 trips in aggregate, as compared to Ruud's prediction of 530,265 trips for the same beaches during the same period.

Thurman's model differed from Ruud's in three main ways: he used different temperature variables and made minor changes to some of the other variables; he omitted the lagged dependent variables; and he adopted a different stochastic specification. Ruud (1994) had conducted a preliminary analysis using a log-linear model of the form

$$(1) \quad \ln(y) = X\beta + \varepsilon,$$

in which the natural logarithm of beach attendance, y, was explained by a linear function of exogenous explanatory variables and lagged dependent variables plus a normal random error term, ε, with zero mean. After estimating a system of equations like (1), Ruud had performed diagnostic tests for first-order autocorrelation and heteroscedasticity in the residuals. The score test statistics unambiguously indicated the absence of autocorrelation, but gave a strong indication of heteroscedasticity. To deal with the heteroscedasticity, Ruud adopted an alternative specification with an additive error

$$(2) \quad y = \exp(X\beta) + \upsilon,$$

[34]Dunford et al. (1995). In our experience, this exaggerates the ease of getting around Los Angeles and ignores the fact that during most hours of the day there is significant congestion on both the Pacific Coast Highway and the inland freeways which most visitors of the beaches closed by the spill would have had to use to reach beaches south of Laguna Beach or to the north in Santa Monica Bay We checked this out by driving the routes that beach users would take and timing the trips (Hanemann Exhibit 909).

[35]In 1991, RTI had estimated preliminary models of attendance for the five affected beaches using monthly attendance data from the lifeguards' reports covering the period January 1981 through December 1990. The RTI models showed a loss of 145,518 beach trips in February and March 1990, without any adjustment to reported attendance during the closure period, and an additional loss of 288,613 trips in April 1990.

where υ is a normal error with zero mean, which he estimated by nonlinear least squares. This was the model that he used for predicting beach attendance. Thurman (1995) first estimated an ordinary least squares model like (1), omitting the lagged dependent variables and making changes to the temperature variables and some other variables. Observing evidence of autocorrelation and heteroscedasticity in the residuals, he then estimated a generalized least squares (GLS) version of (1) incorporating an autocorrelated and heteroscedastic error structure for ε. To estimate predicted attendance, Thurman used the anti-log of the predicted dependent variable in (1), namely exp (Xb), where b was his GLS estimator of β. This, of course, generates an estimate of the *median* of y, which, for the lognormal distribution, is lower than the mean. This oversight accounted for some of the difference in attendance predictions; it was subsequently corrected in Thurman (1996), produced at his deposition.[36] However, we believe that most of the difference in attendance predictions is due to Thurman's use of specification (1) instead of (2), combined with the omission of the lagged dependent variables.

Our own view was that vector autoregression model is a standard procedure for making forecasts in economics and business, and is entirely appropriate for forecasting beach attendance. We felt that Ruud's inclusion of lagged variables accurately captured the complex pattern of autocorrelation that one observes in daily beach attendance. Ruud's goal was to find the best prediction of daily attendance. He used weather variables and other exogenous variables that he found produced the best fit.[37] On inspecting the day-to-day predictions, we found no indication that Ruud's model performed poorly on unusually cold days.[38] We noted that Professor Thurman's model without the lagged dependent variables did not fit the data as well as Ruud's model based on adjusted R^2 statistics. At his deposition, Professor Thurman testified that he had not investigated whether his model fitted the data as well as Ruud's, and he had not performed a non-nested specification test of (1) versus (2) that had been suggested to him by a peer reviewer for TER.[39]

[36] The error was noted in Hanemann (1996). Adjusting the predicted median of y to obtain the predicted mean is non-trivial. Goldberger (1968) and Bradu and Mundlak (1970) discuss some of the complexities involved in the homoscedastic case. Thurman did not provide enough details of his GLS estimation for us to tell whether he had fully adjusted for the predicted mean in his GLS model.

[37] The lifeguards confirmed that, in their experience, the temperature inland usually had more impact on beach attendance than the temperature at the beach. They had also said this to RTI staff in February 1991 (Trial transcript, p 4506).

[38] To convey the impression that the spill period was unusually cold, Dunford used a graph, reproduced as Figure 1 in Dunford (1999), which showed that 1990 had the lowest average maximum daily temperature over the period February 8 - March 9 of any year between 1986 and 1993. But the conclusion did *not* hold if one used other time periods such as the month of February or the month of March. In February 1990 there had been 6 days with a maximum daily temperature of 60^o F. But, in February 1993 there had been 5 days when the maximum daily temperature ranged from 58 to 61^o F and in February 1992, there had been 6 days when the maximum daily temperature ranged from 58 to 61^o F. In 1989 there had been 8 days when the maximum daily temperature ranged from 52 to 59^o F.

[39] Thurman deposition 11/7/96, pp. 32, 106; 11/8/96, pp 159, 175. The reviewer was Professor Matthew Holt, his colleague in the Department of Agricultural and Resource Economics at North Carolina State University.

Disputing the Estimate of Consumer's Surplus

The defendants also criticized the estimates of consumers' surplus that we used to value the recreational losses. In the case of beach recreation, they both criticized various aspects of Bell and Leeworthy's (1986) study and also proposed alternative studies that yielded considerably lower estimates of consumers' surplus.

With regard to Bell and Leeworthy, they objected that this survey involved the recall of beach trips over the preceding year, which was likely to be unreliable, and they criticized the specification of the price variable, the poor fit of the demand equation, the absence of attributes of individual beaches as factors influencing demand, and the sensitivity of the estimates of consumers' surplus to functional form. In addition, Dunford et al. (1995) claimed that the Bell and Leeworthy study violated the necessary criterion of similarity for a benefits transfer exercise because "the beaches in the Bell and Leeworthy study are not similar to the injured beaches" and "there are substantial differences ... with respect to racial composition, gender, age and household income" between Bell and Leeworthy's respondents and the users of the injured beaches.[40] While we were aware of the shortcomings of the Bell and Leeworthy study, the study had been widely cited in the literature, and it was not obvious to us in which direction its potential shortcomings would affect the estimate of consumers' surplus.

The defendants also made the point that Bell and Leeworthy were valuing beach recreation during the summer while the oil spill occurred in the winter when, they claimed, beach recreation should have a lower value. They cited a contingent valuation (CV) survey of beach users by McConnell (1977) which found that beach users gave a lower value for beach recreation on days when the temperature was lower: "for example, reported values when temperatures are 65^{o}F were less than half of values when temperatures were 75^{o}F." But, McConnell's study was conducted during ten days in August 1974 at Rhode Island beaches, and we felt it shed no light on the difference between summer and winter beach recreation in Los Angeles or Florida.[41] It seemed entirely possible to us that, in Los Angeles, the average consumers' surplus *for those people who go to the beach during the winter* could be at least as high as the average consumers' surplus for those who go to the beach in the summer.

Another argument offered against our analysis was that the loss of beach trips during February and March amounted to only about 8% of the total number of trips to these beaches over the year as a whole. Therefore, it was claimed that there should only be a small marginal loss of consumers' surplus. This argument was emphasized by Randy Moss and Dr. Bruce Owen of Economists, Inc.,

[40]Dunford et al. (1995). In support of this assertion, they compared Bell and Leeworthy's respondents with the respondents to a NOAA survey of beach users in Los Angeles County, to be mentioned further below. The NOAA respondents were richer (46% had an income over $40,000, versus 20% for Bell and Leeworthy), younger (mean age of 33.4, versus 43.5 for Bell and Leeworthy), more masculine (57% male, versus 50% for Bell and Leeworthy), and less white (79% white, versus 92% for Bell and Leeworthy). We felt that, if anything, these demographics implied a higher beach value in Los Angeles than Florida, and we were unconvinced that Bell and Leeworthy's Florida study was too different from Los Angeles to be considered for use in a benefits transfer.

[41]In Florida, the summer, though the hottest time of the year, is *not* the high season for beach use; the winter is the high season.

consultants to the TAPS fund, who applied it to the Bell and Leeworthy data and measured the consumers' surplus loss per trip associated with the least valuable 8% of beach trips, which they calculated at around $1 per trip as opposed to the average consumers' surplus of $13.19 per trip. We disagreed because we felt that, in the circumstances of the beach closure, it was the average consumers' surplus per trip and not the marginal consumers' surplus per trip that was relevant. While the marginal consumers' surplus per trip would be appropriate if the authorities had used prices to allocate the reduction in beach use, the actual circumstances created by the oil spill were more akin to non-price rationing where it was agreed in the literature on peak load pricing that the average consumers' surplus was the relevant measure of the welfare loss due to outages.[42]

The defendants also criticized us for not using other sources of information on the consumers' surplus from beach recreation, most especially surveys of beach users in Los Angeles and San Diego counties conducted in the summers of 1989 and 1990 by Dr. Vernon R. Leeworthy, the co-author of Bell and Leeworthy (1986) and now on the staff on NOAA's Strategic Assessment Branch. These surveys were part of a larger multi-year intergovernmental cooperative research project to develop estimates of the economic value of recreational activities on the public lands known as Public Area Recreation Visitors Survey (PARVS).[43] The questionnaire contained a large number of travel cost type questions for beach goers interviewed on site. Dr. Leeworthy and his colleagues had estimated a variety of travel cost models to these data. Using what they considered their most conservative judgments with respect to price definition and specification of functional form, and truncating consumers' surplus at the highest observed price in the data, they obtained the following estimates of average consumers' surplus per trip (in 1990 dollars) for beaches in Southern California: $8.16 at Cabrillo-Long Beach, $18.36 at Santa Monica, $26.20 at Pismo State Beach, $51.94 at Leo Carillo State Beach, located at the northern end of Los Angeles County, $57.31 at San Onofre State Beach in San Diego County, and $60.79 at beaches in San Diego.[44]

At the end of the survey, after all the travel cost questions, there was a closed-ended contingent valuation (CV) question: "Suppose the agency that manages this site started charging a <u>daily</u> admission fee of $X <u>per person</u>. The money from the admission fee will be used to maintain the site in the present condition, but there would be <u>no</u> improvements. Would you continue to use this site?" The daily admission fee was one of 10 randomly assigned amounts between $1 and $75. Most of those who responded said "no." Leeworthy, Schruefer and Wiley (1990, 1991) tabulated these

[42]With this type of outage, *everybody's* consumption is shut down, both those with high consumers' surplus and those with low consumers' surplus. The error of using marginal consumers' surplus in these circumstances was first pointed out by Seneca (1970) and Visscher (1973).

[43]When we wrote our 1994 report we were aware that Dr. Leeworthy had conducted surveys of beach users in Southern California, but we had not seen any results of the surveys or any of Leeworthy's analysis. The data are summarized in Leeworthy, Schruefer and Wiley (1990, 1991). Leeworthy's first report on his analysis of PARVS data, using data from a 1988 survey at Island Beach State Park in New Jersey in the summer of 1988, was published in Leeworthy and Wiley (1991).

[44]The results for Cabrillo-Long Beach, Santa Monica and Leo Carillo are reported in Leeworthy and Wiley (1993); the other three results were in a personal communication, Leeworthy (1995). All of these results are based on single-site models. Leeworthy (1995) wrote that he also estimated a pooled cross-section model for the Southern California Region. "The data were weighted by total site visitation when pooling across sites. A count data model, using the Poisson regression (both truncated and untruncated models) was estimated. Results here on a per person per day basis for the consumers' surplus were $44.52 for the untruncated model, and $23.58 for the truncated model."

responses, but did not analyze them further for an estimate of willingness to pay (WTP) because they felt that the payment vehicle was flawed. These were public beaches, which people already supported through their tax dollars. Leeworthy felt that beach users might have resented the notion of paying a charge just to walk onto the beach (which is virtually unheard of in California) as opposed to paying a fee for some specific service such as parking; and they might have especially resented the notion that the revenues would not be used to improve the beach in any way.

The defendants rejected the travel cost component of the PARVS survey, but they embraced the CV data with enthusiasm. Dunford et al. (1995) obtained the PARVS data from Leeworthy and fitted a WTP model to the CV responses. They obtained estimates for the mean WTP per trip of $2.17 for Cabrillo-Long Beach, $2.33 for Santa Monica, and $3.38 for all California sites combined. Based on this, they decided to use $2.30/trip as their best estimate of the value per trip for the lost beach recreation.

Several aspects of their analysis struck us as questionable including the fact that they analyzed the CV responses without any reference to the respondent's actual travel cost, they selected the two least valued Southern California beaches to represent the beaches affected by the oil spill,[45] and their welfare calculation implied that beach users' WTP to go to the beach is *negative* in the left tail of the distribution.[46] Beyond this, there were two fundamental reasons why we considered the PARVS CV data unsuited to the purpose for which Dunford et al. were using them. The first is "protest zeroes" – i.e., respondents who say "no" to a CV survey not because the item is not worth that much to them but rather because they feel that *they* should not have to pay for it in the manner proposed. In our view, the form of the payment vehicle made this likely. There was data from the PARVS survey itself to substantiate this concern.[47] At the end of the on-site interview, respondents were asked to supply a mailing address so that they could be sent a short questionnaire covering additional information on their expenses during the trip. The closed-ended CV question was repeated in this mail survey. In the mail survey, but not the on-site survey, there was also a follow-up question for people who answered "no" asking them to check the reason for their response. We subsequently examined the mail survey responses for the Southern California beaches and concluded that a

[45] These are Cabrillo-Long Beach, where there is a heavily urban setting unlike that at the beaches affected by the spill, and Santa Monica Beach. In February 1991, RTI staff had been told by lifeguards there that "Long Beach is too filthy to swim in usually" and had concluded that it "may not be a good control beach." Dr. Dunford assumed that Santa Monica referred to Santa Monica City Beach, which is fairly comparable to the affected beaches in several respects other than surfing -- the surfing is much better at the Orange County beaches. However, we researched this and found out from Dr. Leeworthy that Santa Monica referred to certain *other* beaches in Santa Monica Bay – Dockweiler, Manhattan, Hermosa and Redondo Beaches -- which are less attractive and have less convenient parking than either Santa Monica City Beach or the Orange County beaches.

[46] In a subsequent paper for an academic conference, Dr. Dunford modified his analysis to assume that WTP for beach recreation is non-negative; this raised his estimate of mean WTP per trip for all California beaches combined to $4.74 (Dunford and Fowler, 1996).

[47] Other evidence of public opposition to this payment vehicle in Southern California comes from an incident in March 1992 when the Santa Barbara County Board of Supervisors permitted the Nature Conservancy to introduce an entrance fee to walk onto Guadalupe Beach. There was a public uproar because, in the words of an outraged citizen, "a free beach is a God-given and American right." Under intense pressure, the Supervisors rescinded their approval of the entrance fee in June 1992 (*Santa Maria Times* 4/14/92, 11/12/92). Twenty years earlier, in 1972, California voters had approved a proposition guaranteeing the public right of access to the shoreline.

minimum of *one third* of the negative responses to these CV question were likely to be protest zeroes because the respondent either checked "I do not believe fees should be charged" or gave another reason such as "they shouldn't charge pedestrians" or "taxes should be used to maintain and improve the facility." The proportion of protest zeroes among the responses to the on-site survey is likely to have been higher because the protest zeroes are more likely than others to have been non-respondents to the mail survey.[48]

Second, even with protest zeroes properly accounted for, we do not believe that the PARVS CV can provide an estimate of use value applicable to the loss of beach recreation caused by the *American Trader* oil spill. The CV question values a single beach taken by itself, with no change or interruption in the availability of any other beach in the area.[49] However, the essence of what happened in February and March 1990 is that multiple beaches were closed simultaneously -- almost all beach recreation in that part of Orange County was effectively shut down for a period of time. If the beaches in that area are substitutes for one another, Carson, Flores and Hanemann (1998) show that the loss of consumers' surplus from the closure of one beach is *raised* by the simultaneous closure of another substitute beach. Even if there were no other problems the PARVS CV questions would not capture this, leading to an underestimate of the welfare loss per trip during the closure period.

With respect to the PARVS travel cost data, Dunford et al. had nothing to say about this data and did not mention the estimates of consumers' surplus that Leeworthy and Wiley's (1993) derived from it.[50] Deacon and Kolstad (1995) did mention the PARVS travel cost data but they rejected it as unreliable, and focused instead on the CV results.[51] Unlike Dunford et al. (1995), Deacon and Kolstad (1995) went to some lengths to review the literature on valuation of beach recreation, as indicated in Table 2. They identified a number of relatively obscure studies including Silberman and Klock (1988), and Curtis and Shows (1982, 1984), which used an open-ended CV to value beach recreation. Their citations from the valuation literature were distinctly weighted towards CV. In addition to not citing the analysis of PARVS travel cost data by Leeworthy and Wiley (1991, 1993), they cited Hanemann and Binkley's analysis of the CV data collected in the 1974 Boston area beach recreation survey, but not the analysis by Hanemann (1978) or Meta Systems (1985) of the travel cost data collected in that survey. On the basis of the studies they had cited, they concluded that "the

[48]There was only a 23% response rate for the mail surveys at the Southern California beaches, and 11% of these respondents did not answer the CV question.

[49]The mail survey responses confirm that this is how respondents interpreted the question.

[50]We found their position curious. They expressed the opinion that "the random utility model (RUM) approach, a sophisticated variation of the travel cost method, provides better use-value estimates than any other non-market valuation method. .. It is ideally suited for measuring recreation use damages resulting from oil spills." Absent such data in the PARVS survey, for unexplained reasons they preferred what they called "a high-quality CV study" over the travel cost data that *was* collected in the PARVS survey. Ironically, in 1990 RTI *had* collected data suitable for estimating a RUM model at beaches affected by the spill, but Dunford et al. never made any reference to it and never used it to estimate a RUM model.

[51]They objected that the PARVS travel cost data included not just local residents but also respondents who were from out of state and even abroad, which made the price variable unreliable. They did not address the fact that the same respondents were also in the CV data. In fact, the travel cost model selected by Leeworthy and Wiley (1993) excluded outliers, which is likely to have eliminated many non-residents.

value of a winter beach day in California ... is likely to be in the under-$5 per day range."[52]

5. PREPARATION FOR THE TRIAL

During 1996 and 1997, as prospects for a settlement with ATTRANSCO faded, we prepared for trial. Our work proceeded in four phases. The first phase was conducting a beach count survey in February and March 1996 to investigate the accuracy of the lifeguards' reports of attendance during that time of year at the beaches affected by the spill; the findings were reported in Hanemann (1996). This was followed by preparation for the depositions of Chapman, Ruud, Thurman, Hanemann and Dunford in September, November and December, 1996. Subsequently there was a legal fight over documents which Dr. Dunford had brought to his deposition but were withheld by ATTRANSCO's attorney. This ended in February 1997 when the court ordered that the documents be turned over to us. The third phase was conducting a boating and surfing survey in Orange County in February and March 1997, whose findings were reported in Hanemann (1997a). The fourth phase was preparation for the depositions of Hanemann and Dunford in August 1997, including the production of a final report on our conclusions, Hanemann (1997b). This work had three main goals: to improve our estimate of the number of beach trips lost due to the spill; to break out surfing from general beach recreation; and to refine our estimates of unit value for surfing and general beach recreation.[53] As we obtained information and data from Dr. Dunford through the deposition process, we modified and refined our analysis.

Verifying the lifeguards' reports of attendance in a reliable and systematic manner through some form of survey had long been on our minds. But, we estimated that to do this right would cost $50,000 or more. As long as the Trustees thought that the case would settle, they were reluctant to authorize spending on that scale. Now that a trial seemed imminent, they allowed us to go ahead, with the full understanding that they would have to live with whatever we found.

An important factor in their decision was information they received that Professors Deacon and Kolstad had conducted an aerial survey of some of the affected beaches in February and March, 1995. When they compared the results with the lifeguard reports of attendance for those days, Deacon and Kolstad concluded that the lifeguard reports significantly overstate actual attendance.[54]

Overflights are a relatively inexpensive way to measure beach attendance at a particular point in time -- one photographs the beach from a low-flying plane, and then counts all the people in the photograph. By itself, however, this is not conclusive. One doesn't know the number of people on the beach the rest of the day, and one doesn't know whether the people seen on the beach on different overflights are the same or different -- it depends on beach visit duration. To deal with this Deacon and Kolstad had stationed interviewers at the beach on the day of the overflights who stopped people and asked them when they had arrived at the beach that day and when they expected to leave. From

[52]Their recent paper, Kolstad and Deacon (2000) reviews the same literature and, as indicated in Table 2, now drops several of these studies "due to limitations with the data or methodology used," but does not add any new ones. They conclude by recommending a value for saltwater beach recreation in the range of $1-4 (1990 dollars).
[53]A fourth goal was to refine our estimate of boating trips lost due to the spill.
[54]They have described the survey and their findings in Kolstad and Deacon (2000).

the survey responses, Deacon and Kolstad produced an estimate of mean visit duration. The overflights were conducted at 11 am, 1:30 pm and 4 pm on two week days and three weekend days. At Huntington City Beach on Friday February 17, 1995, for example, 345 people were counted on the beach from the aerial photographs at 11 am, 700 people at 1:30 pm, and 555 people at 4 pm. Deacon and Kolstad estimated the mean visit duration at 1.91 hours that day. They assumed that there were no people on the beach before 6 am, and that instantaneous attendance then rose linearly from zero to 345 at 11 am; for instantaneous beach attendance between 11 am and 4 pm they extrapolated between the three aerial counts. To extrapolate after 4 pm, Deacon and Kolstad used an estimate of the number of people on the beach at 6 pm developed by the interviewers on the ground. They summed their estimates of instantaneous attendance from 6 am to 6 pm, and then divided this total by the estimate of mean visit duration to obtain their estimate of the total number of visits to the beach. Their estimate for Huntington City Beach on February 17 was 2,676; this was well below half the total attendance reported by the Huntington City Beach lifeguards that day, which was 6,242. At Newport Beach, the discrepancy between their estimate of attendance and the life-guards' report was even greater.

However, their estimate depends on some assumptions which are open to question: there is nobody on the beach before 6 am or after 6 pm (both of which were are inconsistent with data from the on-site interviews), attendance grows linearly from 6 am to 11 am (the evidence is that there is an initial pulse of early morning surfers and beach-goers), and the estimate of mean visit duration.[55] Moreover, when converting from aggregate instantaneous visitation to the number of separate visits, they assumed that one over the mean of visit duration is a good estimate of the expectation of the reciprocal of visit duration, which is incorrect: for a positive random variable x, $1/E\{x\}$ is *not* a good estimate of $E\{1/x\}$.[56] The failure to allow for this may have reduced their attendance estimate by 40 - 60%, given the distribution of trip durations in their survey. When all these factors are considered, the conclusion regarding the accuracy of the lifeguards' reports of attendance was less clear-cut.

The best way to resolve this, in our view, was a careful, ground-based count of beach attendance using observers on the beach to count people as they arrived. We conducted this beach count survey at the beaches affected by the spill on randomly selected days during the period from February 10 to March 17, 1996.[57] To implement the count, we hired interviewers from a local survey company to serve as enumerators, we selected sampling locations, we trained the enumerators, and we designed a sampling plan that provided coverage of the beaches for 12 hours per day, with each team of enumerators working half-an-hour on and half-an-hour off from 6:30 am to 6:30 pm.[58] In all,

[55]While they were careful to correct for the over sampling of longer trips, they made no adjustment for the uncertainty when somebody who arrived at the beach at, say, 1 pm and is interviewed at 1:45 pm says he is going to stay at the beach until 10 pm.

[56]The relevance of this for the estimation of beach attendance from aerial photographs is pointed out by Tourangeau and Ruser (1999).

[57]The lifeguards informed us that there had been no changes since 1990 in the patterns of beach attendance, or their methods of reporting attendance, which would render it inappropriate for us to develop a correction factor for estimates of beach attendance in 1990 based a comparison between their reports of attendance and our more comprehensive count of beach use in 1996.

[58]For our attendance estimate, we doubled the half-hour counts. The sampling design is described in Tourangeau (1996).

there were 57 individual beach count days, randomly assigned over the 5-week survey period, with over sampling of weekend days and Fridays relative to the other weekdays.[59] To deal with beach users who leave the beach during their visit and then return, we designed a separate repeat visitor survey. This was conducted by a separate interviewer on two week days and two weekend days at each beach. The interviewer sampled every tenth person entering the beach and asked them "Is this the first time that you have come onto the sand at a beach today?" If the answer was "no," the interviewer asked "Where did you come onto the sand at a beach earlier today?" [60] The results were used to adjust the attendance estimates from the main beach count survey.[61]

When we compared the results of our counts with the lifeguards' reports of attendance for those same days we found that, on any given day, there usually was some discrepancy, but the discrepancy could be in either direction: some days, the lifeguards reported a larger attendance than we had counted, and some days a smaller attendance. On Saturday March 9, for example, the lifeguards at Newport Beach reported an attendance of 45,000 while our count from the beach survey was 19,699. However, on Saturday February 24, the lifeguards at Newport reported an attendance of 22,000 while we counted 22,767, and on Saturday February 10 the lifeguards at Newport reported an attendance of 3,500 while we counted 10,958. At the state beaches, while we observed fewer people per vehicle than the conversion factors used by lifeguards, we also observed a higher ratio of walk-ons to drive-ins than they assumed. Extrapolating from the survey days to the entire 5-week survey period, the attendance reported by the lifeguards at the three state beaches combined understated our count of beach attendance by 4.2%, while the attendance reported by the lifeguards at the two city beaches combined overstated our count of beach attendance by 13.3%.[62] For all five beaches combined, the attendance reported by the lifeguards over the 5-week period exceeded our count of attendance by just 9.4%.

The comparison revealed a distinct pattern in the reporting errors. The lifeguards cover attendance for only part of the day, and they tend to miss out on early morning and late afternoon attendance. On the other hand, while their estimates are fairly accurate for normal attendance, they tend to overstate attendance when large crowds show up.[63] The result is a tendency to understate

[59]The survey schedule at the city beaches called for 6 weekend survey days, 3 Fridays, and once each for the other days of the week, for a total of 13 survey days per beach. There was a similar schedule at the two main state beaches, involving 12 survey days at Bolsa Chica and 11 survey days at Huntington State; at Crystal Cove, which is much smaller than the other two state beaches, we had 8 survey days. On two survey days there was no official report of attendance because parking booths at state beaches were not being manned on those days. This left 55 survey days for making the comparison between our counts and the official reports of beach attendance.

[60]This is the wording used at city beaches. At the state beaches, the wording was modified to fit the different logistics of entry to state beaches.

[61]Another special survey was the count verification survey, in which two interviewers made independent counts of the number of people entering a specific segment of beach during a particular time slot. Afterwards, the two counts were compared to see if they matched. In 20 such tests there was never any disagreement in counting cars, but there was a minor disagreement in counting people in 4 of the 20 tests. For all tests combined, the overall accuracy rate for counting beach attendance was 98.9%.

[62]Note that our count was deliberately conservative since, to simplify the sampling design, we excluded people using piers or the boardwalk at the city beaches, but not stepping on the sand. The lifeguards did count these people, and some of them would undoubtedly have lost recreation because of the spill

[63]Two factors may account for the this tendency. First, the number of people per vehicle may decline when there is a

attendance on days with low attendance and overstate it on days with high attendance. If one plots our count of daily attendance (on the vertical axis) against the lifeguards' report of daily attendance (on the horizontal axis), the shape of the graph looks something like a logarithmic function for both the city and the state beaches. We ran logarithmic, exponential, and Gomperz regressions of our counts versus the lifeguards' reports and found that the exponential model -- similar to (2) above -- fitted the data best. We could not reject the hypothesis that the regression equations are the same across the city and state beaches, and therefore used a single equation for all beaches pooled.[64] We used the pooled exponential regression equation to correct both the *predictions* of beach attendance in the absence of a spill during the period February 8 - March 31, 1990 from Ruud's model, and also our estimates of the beach recreation that *did* occur during this period.[65] Our revised estimate of lost beach use during this period was about 618,000 trips, as shown in the second panel of Table 1.

Following the reports on the 1996 beach count survey, the next major event was the depositions in September, November and December, 1996. From our perspective, an important aspect of the depositions was the opportunity it afforded us to see for the first time the information that had been collected by RTI/TER. Since Dr. Dunford's public position had been that he was unfamiliar with the lifeguards' attendance data and had no estimate of his own for the loss of recreation, we were interested to learn that, in 1990 and 1991, RTI had contacted the same lifeguards and had collected the same data from them as we did, and had used this to estimate a similar model of beach attendance. We were also interested in an extensive collection of clippings from the *Orange County Register* that Dr. Dunford turned over. In particular, we noted a story about some surfers going to other sites because their usual sites were closed as a result of the spill; we had not seen a story to this effect in the *Los Angeles Times*, which we had monitored on-line for the duration of the spill.[66]

We therefore decided to make an attempt to collect some more information about the effect of the spill on surfers, and to break surfing out from general beach recreation. To accomplish the latter, we conducted a second beach count survey in February and March 1997, designed to collect information on the proportion of surfers using each beach. We employed the same methodology as in our 1996 survey but on a smaller scale, involving only 22 individual beach survey days spread over the four main beaches, excluding Crystal Cove. At each beach, we counted the number of

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large turnout. Second, it is known from the literature on the sociology of crowds that, when there is a large crowd, while a greater fraction of the meeting space is filled, the average density of people per square foot may be lower with a larger crowd; the variation in density can cause visual estimates made from ground level to overstate the size of large crowds (McPhail et al. 1997).

[64]Hanemann (1996). We found that the day of the week and the weather had no effect on the reporting error once one controls for actual attendance.

[65]In the course of conducting the beach count survey, we collected the lifeguards reports of daily attendance for all the days in February and March 1996. Paul Ruud compared these actual reported attendances with his predictions of attendance for each day at each beach, using his model from Ruud (1994). He found that the 1996 data were substantially consistent with his original model, except that the original model somewhat under predicted 1996 attendance at Bolsa Chica and Huntington City Beaches. He therefore saw no reason to modify his model in the light of the 1996 data (Ruud, 1996). Thus, the change in "adjusted attendance" and "predicted attendance" numbers in the first and second panels of Table 1 is due not to any change in Ruud's model but solely to the correction we made based on the 1996 survey to adjust actual and predicted lifeguards' reports of daily attendance to the counts that we would have observed if we had conducted a beach count survey.

[66]*The Orange County Register* was not available online, and we had not seen its full coverage of the spill.

surfers and non-surfers entering the beach. We found that the proportion of beach trips accounted for by surfers was 9.9% at Newport beach, 13.9% at Huntington City Beach, 14.9% at Bolsa Chica, and 17.5% at Huntington State Beach (Hanemann, 1997a).

We also collected the official reports of beach attendance for the survey days, and compared them with our counts. We obtained the same results as in 1996 -- extrapolating to the full 5-week period of the survey, in aggregate the official reports exceeded our counts by about 9.4%, and the same regression equation was consistent with both years' data. We saw no reason, therefore, to revise our estimate of 618,000 lost beach trips between February 8 and March 31, 1990, but we now subdivided these into lost surfing trips and lost general beach recreation trips using the proportions of surfers from the 1997 beach count survey.[67]

To prepare for the 1997 beach count survey we conducted two focus groups with surfers, in the course of which we asked if anyone remembered the 1990 oil spill and how had they been affected.[68] Everyone who was an active surfer and lived in the area in 1990 remembered the spill and had been affected by it. On weekends, they had been able to go to other locations outside the spill area but, on weekdays, they could not manage the extra time needed to travel outside the area and they generally gave up their surfing.[69] Overall, for this group, about 50% of their surfing trips were lost, and 50% were made to substitute sites outside the spill area. We therefore decided to assume that only half of the surfing trips lost at beaches affected by the spill between February 8 and March 31, 1990 were ultimately lost, and the other half were offset by trips made to other, substitute sites.

With regard to general beach recreation, however, we still found no evidence of spatial substitution by the general public; the information available indicated no net increase, or perhaps a net decrease, in attendance at beaches outside the spill area during February and March, 1990. Therefore, we saw no reason to revise our assumption of no net substitution for non-surfing trips lost at the affected beaches between February 8 and March 31, 1990.

In addition to refining our estimate of lost beach and surfing recreation, we also worked to improve our estimate of lost consumers' surplus per trip. We had two new pieces of information

[67]For Crystal Cove, we assumed that surfers were 9.9% of total beach users.

[68]A separate component of the 1997 survey dealt with counts of boating activity at harbors affected by the oil spill. In preparing for these counts, we planned to conduct two focus groups of boaters, one dealing with people who launched their boats from public boat ramps in these harbors. That focus group turned into a natural experiment on the value of boating. We had recruited 14 users of boat launches who had agreed to attend a focus group in Irvine at 1 p.m. on Sunday February 2, 1997 in return for a payment of $50. That morning, however, eleven people phoned in to say that they would not be coming because it was such a nice day for boating. In the end, only one person out of the 14 recruited showed up. We inferred that the median value of boating to these people exceeded $50/trip. In Hanemann (1994) we had used a value of $34/trip for boating based on studies of boating in the Sacramento Delta and at Sierra reservoirs by Spectrum Economics (1991) and Mannesto (1989).

[69]One of the beaches in the area, Seal Beach, a surfing beach, was open for most of the spill period. However, the surfers in the focus group considered it an unattractive substitute due to its relatively small size and wave congestion, combined with extreme territoriality by the regular surfers there; it also had a reputation for poor water quality due to storm water runoff. Most of the surfers in the focus group said that on weekends during the spill they went south to surf at San Clemente or at San Onofre Beach in San Diego County. This is highly consistent with the responses by the surfers whom RTI interviewed when the beaches re-opened in March 1990 (see below).

since completing our 1994 report. First, we had received a copy of the Department of Interior's (DOI) revised Type A Natural Resource Damage Assessment Model for Coastal and Marine Environments, which included a value for beach recreation (French et al., 1996, Section 10.3.3). The DOI report contained a literature review that selected seven studies for consideration, as indicated in Table 2. The report used the average value from these studies -- about $11.00 in February 1990 dollars -- as "representative of the available empirical results of the value of a day at the beach. ... This average net value represents a best estimate for the baseline value of a general beach recreational opportunity."

Second, once we knew of the availability of the PARVS data for Southern California beaches we obtained a copy and conducted our own statistical analysis of the travel cost data. To be conservative, we restricted our analysis to one-day beach trips by residents of Southern California. In order to avoid sensitivity to functional form, we estimated the recreation demand functions non-parametrically using a kernel estimator.[70] In our estimation, we corrected for the sampling bias that is associated with an intercept survey by weighting the data proportionally to the inverse of the number of beach trips.[71] Non-parametric estimation is necessarily limited to the range of prices covered in the data; with a sample of beach users, therefore, it provides no information on the part of the demand function in the vicinity of the cut-off price, which determines the upper corner of the Marshallian triangle. To handle this, we made a conservative assumption about the cutoff price based on an assessment of the spatial extent of the market for each site, and then calculated the upper part of the Marshallian triangle using a linear interpolation to the upper end of the non-parametrically estimated demand function. We tried several treatments including using log price instead of price and travel cost at 13 versus 21 cents per mile (the latter was the cost reported by respondents in the PARVS surveys). We focused on Cabrillo Beach and Long Beach (broken down separately) and, Santa Monica and San Diego Beaches, both separately and pooled. We estimated the predicted consumers' surplus per trip at approximately $35-40 for Long Beach and San Diego, and $20-25 for Cabrillo, Santa Monica and all four beaches pooled.

We believed that the beaches affected by the *American Trader* oil spill are better than an average beach in the U.S. Therefore, we considered that the consumers' surplus associated with the use of these beaches was some amount higher than DOI's estimate of $11 for a generic beach trip. Our own nonparametric analysis of the PARVS travel cost data supported Leeworthy's parametric estimate of $23/trip for Southern California beaches pooled. Based on this our final conclusion was that a reasonable range for the consumers' surplus from general beach recreation at the beaches affected by the spill would be $11-23/trip, in 1990 dollars. Our specific point estimate, intended to be conservative, was $15/trip.

We believed that a different value should be used for surfing, since it is a more specialized activity that requires a higher degree of skill, knowledge and appreciation, and draws a very loyal

[70]The nonparametric analysis was conducted by Michael Ward. He chose the narrowest bandwidth that was consistent with a monotone downward sloping demand function for each site.

[71]Chapman, Hanemann and Ward (1998) prove that this also corrects for the truncation bias associated with sampling limited to beach users. The over sampling of more frequent beach users had not been taken into account by Leeworthy and Wiley (1993) or, indeed, by Dunford et al. (1995) when they analyzed the CV data.

following. Based on the travel cost literature, we believed that the consumers' surplus for surfing in Orange County was likely to be at least 25% higher than the consumers' surplus for general beach recreation, and we therefore used a value of $18.75/trip in 1990 dollars for surfing trips lost.

As noted above, we assumed that half of the affected surfing trips were offset by substitution to beaches outside the area. This still entailed some loss of consumers' surplus, due to the increased cost of travel. For a surfer who lived in Huntington Beach and went instead to San Clemente, there would be an extra 74 miles of round-trip travel and an extra 90 minutes of travel time. For one who lived in Anaheim, the second most common city of origin for visitors to Huntington Beach, and went to San Clemente instead, there would be an extra 38 miles in round-trip travel and an extra 38 minutes in travel time. To reflect this cost, we used $12/trip as our estimate of the average loss of consumers' surplus for surfing trips diverted to substitute sites.

At Dr. Dunford's deposition in December 1996, ATTRANSCO's attorney withheld some of the documents that he had brought along to comply with a document production request. In February 1997, the Court directed that these be turned over. Among them were a number of documents containing portions that had been redacted. In May, the Court directed ATTRANSCO to turn over unredacted versions of the documents. Among the documents we then obtained were various materials relating to a survey that RTI had conducted at the affected beaches in Orange County immediately after the beaches re-opened, comprising on-site interviews with about 560 beach users during March and April, 1990. The interviewer asked about the travel time, distance and mode of transportation for the current trip, what activities they engaged in and how long they had been there, and then continued, "Now I'd like to ask several questions about your use of beaches earlier this year. About how many trips to the beach did you make in February? Which beaches did you visit? Would you also describe your typical recreational activity and the approximate number of hours you stayed on a typical visit?" The same questions were then asked for beach trips in January. At the end, the interviewer asked about the respondent's education, occupation, race and income. The survey was designed to collect information "that will allow us to estimate the value which surfers and other users give to a trip to the beach" (Morton et al., 1991). It was apparent, however, that RTI subsequently did not perform this analysis. We decided to try to obtain the data with a view to doing this. Since the documents we had received did not include the data from the survey or the sampling plan, we asked the State's attorneys to press ATTRANSCO further. This resulted in the production, in June, of 35 floppy diskettes that ATTRANSCO's attorney had inadvertently overlooked. These contained about 700 electronic files which RTI staffers took with them when they moved to TER in October 1994. There was no documentation for the contents of these files. On searching through them, we found no master copy of the survey data, no codebook, and no account of the sampling design or the sample weights.[72] [73] In the absence of this information, we were unable to proceed with using the RTI survey data to estimate a travel cost model.[74] [75]

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[72]There were multiple files with the same name but different contents, including 7 separate files containing what appeared to be the survey data but with differing numbers of observations and of variables, and no explanation for the differences. There was a similar experience in the State of Montana's suit for natural resource damages in the Upper Clark Fork Basin, where RTI had conducted a travel cost survey for the defendants in 1992-93. With the Montana survey, too, TER turned over a huge mass of files in 1995 lacking documentation, including multiple files with the same name but different contents, and without a master copy of the survey data or a codebook.

[73]The State's attorneys filed a request for the original questionnaires from the survey. It was then learned that, when

Nevertheless, we did find some information from the survey that was of interest. After the travel cost questions, the interviewer asked "Do you think the condition of the beach is better, worse, or about the same as it was before the spill?" These questions had been added at the insistence of BP, which was co-funding the survey along with ATTRANSCO. The responses were perhaps not what the survey's sponsors had wished to hear, and we suspect that this is why the survey had been placed, as it were, in a deep freeze. Even eight weeks after the beaches had re-opened, 50% of the respondents at Huntington City and Bolsa Chica State Beach, and 43% at Newport Beach, felt that the condition of the beach was worse than before the spill.[76] When asked in what way, 56% of respondents cited oil or tar balls, 54% cited appearance or odor, and 26% cited lower quality recreation.[77] It was also noteworthy that 37.5% of the beach users intercepted in the survey reported that they were engaged in surfing, since this was far more than the 10-18% of beach users we had observed to be surfers in our 1997 beach count survey.[78] The unusually high proportion of surfers would be consistent with the hypothesis that non-surfers were tending to stay away from the beaches after they re-opened while surfers, being more avid, went back as soon as possible. It would explain the overall lack of spatial and temporal substitution that we were finding. It would also imply that there had been some loss of beach recreation in April as well as March 1990.[79]

Dr. Dunford moved from RTI to TER in October 1994, he left these and other materials relating to the survey behind at RTI. Following its usual policy for materials from inactive cases, RTI waited for a period and then destroyed them, probably towards the end of 1996. When the Court learnt of this, it sanctioned ATTRANSCO for the destruction of evidence.

[74]When asked at his deposition on 12/10/96 "Have you or any members of your team ever done any beach surveys in connection with any aspect of the *American Trader* incident?" Dr Dunford answered "No." On 12/13/96, he was again asked "and you have not performed any original studies, correct?" and he answered "I have not....I was not asked by my client to do such a study" (Dunford depositions, pp. 35-36, 538). Sara Hudson, a co-author of the 1991 report on the RTI survey, was working on the case for Dr. Dunford at the time of these depositions. Dr. Dunford subsequently testified that he had reviewed the report on the survey when taking over as manager of the case. He did not mention the survey at his deposition because, "I did not rely on any of this survey information for my opinion and my report." He told ATTRANSCO's attorney " I did not feel that any of that information was relevant and met the terms of the request for document production. And therefore, I don't think that I need to produce these. And he said, well, if that's the way you feel, that's fine." (Dunford deposition 7/23/97, pp. 30-31). Dr. Dunford said that he felt that the attendance estimates from the survey were "not all reliable and accurate estimates" and "I dismissed [the survey] from the very beginning when I started working on the case" (Trial transcript, pp. 4594, 4597). In Dunford (1999) he elaborated that "two of the main oiled beaches were excluded from the sample frame. Furthermore, too few interviews were completed at some of the included beaches to produce statistically meaningful results. Thus, the chance that the RTI survey would yield reliable results was very low." It should be noted that one of the designers of the RTI survey was Ronaldo Iachan, a sampling statistician and expert on recreational surveys (Iachan and Kemp, 1995). The report he co-authored, Morton et al. (1991), expresses a different view from Dunford's with regard to the meaningfulness of the survey results. The sample sizes -- 151 interviews at Huntington City Beach, 116 at Newport Beach, and 119 at Salt Creek beach -- would not usually be considered too small to be reliable for a travel cost study, especially since the respondents may each have taken several trips to various beaches over the two months covered by the survey.

[75]The 1990 RTI survey had also included a boat count at harbors and launch ramps affected by the oil spill, similar to the boating count survey we conducted in 1997. However, the boat count data had not been used by Dr. Dunford, and none of it appeared to have survived.

[76]When Sunset, Surfside and Seal Beaches are included, the overall percentage of respondents over the 8 weeks of the RTI survey stating that the beach was in a worse condition than before the spill was 37%.

[77]Morton et al. (1991) Figures 6-1, 7-1 and 7-2.

[78]Morton et al. (1991) Figures 4-2.

[79]In fact, the RTI report on the survey gives an estimate of the total attendance at Huntington City and Newport

In the light of this new information, we decided to add a component to our estimate of beach recreation loss that would account for the reduction in consumers' surplus that we believe occurred when people went to the beach but found that the quality of their recreational experience was impaired due to the abnormal circumstances created by the spill. This diminution of utility enjoyment applied to people who used the affected beaches in February, March and April 1990, both while the clean-up was still progressing and immediately after re-opening. We felt that a rough but reasonable estimate for the loss of utility when recreation was occurring under adverse conditions was 20% of the consumers' surplus for a normal general beach recreation trip, or $3/trip in 1990 dollars. We applied this loss to all the beach and surfing trips that did occur at the affected beaches between February 8 and March 31, 1990; we also applied it to 37% of approximately one million beach and surfing trips that were made to these beaches in April 1990.[80]

As indicated in Table 3, our overall estimate for the value of lost beach recreation, including both surfing and general beach recreation was $11,420,619 in 1990 dollars. In addition, we estimated the loss of boating recreation at $762,420 in 1990 dollars.[81] These two losses, totaling $12,183,039 were what the State presented to the jury at trial. At the trial, we also testified that, if the loss were adjusted by the increase in the Consumer Price Index between the time of the spill and the time of the trial, this would raise the damage estimate to about $14.5 million.

6. THE TRIAL

The argumentation in the economic portion of the trial focused largely on the concept of consumers' surplus, the quality of the lifeguards' data and the estimates of the number of beach trips lost as a result of the spill, and the value that should be applied to these trips.

The objectives of the State's attorneys in this phase of the trial were: (1) to demonstrate to the jury the painstaking nature of our efforts to collect the best possible information about beach-related recreation in Orange County and the effect on this of the oil spill; and (2) to demystify for the jury the economic concept of consumers' surplus and make it a matter of commonsense to them that they should award damages to the State for the publics' loss of the use and enjoyment of public beaches. They were successful in both objectives. Part of their success was due to a skillful strategy for managing the exposition of the State's case. The case rested on a mass of tedious detail conjoined with potentially impenetrable economic and statistical argumentation. To render this both transparent and credible, without overloading the jury, they presented the State's case in successive iterations,

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Beaches during April 1990 and compares this with the lifeguards' attendance data for the same period in 1986-1989, suggesting a loss of several hundred thousand trips in April 1990 (Morton et al., 1991, Figures 3-1, 3-2 and 3-3). In the absence of the survey data and information on the sampling plan and the survey weights, we were not in a position to verify this figure.

[80] Apart from the diminution in utility, we did not assume any actual loss of beach trips in April 1990.

[81] Party/charter boat sport fishing trips lost were valued at $83/trip in 1990 dollars, using the value from Walsh et al. (1988) for all saltwater fishing modes combined. This was slightly more conservative than the value of $87.12 /trip from a Southern California fishing study by Jones and Stokes (1989), which had been used in Hanemann (1994). Private boating trips were valued at $40/trip, a figure we considered conservative in the light of our experience with the canceled focus group mentioned in footnote 68.

through the successive testimony of Chapman, Ruud and Hanemann. Each gave a more detailed explanation of the State's approach, building on what had been said before and paving the way for what would be said next. While formally entering documents into evidence, the attorneys took Chapman through all the data that we had assembled, filling a large box with papers and reports. "That box" became something of a running gag during our direct examinations; at the same time, it was a tangible symbol of our research-oriented approach to analyzing the effects of the spill.

As the judge stated in his directions to the jury, the plaintiffs were entitled to receive "damages for the loss of use and enjoyment of public beaches and other public resources or facilities."[82] What was at issue was the measurement of this loss of use and enjoyment. The State's attorney argued that these were real economic damages, they could be measured, and the appropriate measure was the loss of consumers' surplus from beach recreation, which was a well-known and accepted concept in economics. While Dr. Dunford was on record as agreeing with those statements, ATTRANSCO's attorney challenged them vigorously. This is the very first trial for consumer surplus in the United States," he told the jury.[83] He employed three main lines of attack. First, he argued that consumers' surplus was "totally speculative," and not something real: "If you intended to go to the store and buy a pair of dockers and you've budgeted $80 ... and if you find those dockers for $40, you have made a consumers' surplus of $40. Now, whether that is real money is for you [the jury] to determine."[84] Moreover, he argued, there was no direct evidence that anybody *had* a consumers' surplus of $15 for beach recreation. "Did you interview anybody and ask them what their consumers' surplus would be for a day at the beach?" he then asked Hanemann. Second, he argued that there could not have been any real loss of consumers' surplus when the beaches were closed because "618,000 people didn't sit home, drinking their beer and crying they couldn't go to the beach. They did something else. They went to the mall."[85] Thirdly, he objected that the value we were using was an average, which made it unreliable. "Professor Hanemann also says that a babe in arms suffers the same loss of consumers' surplus as the parents. You simply will have to judge whether that kind of mathematical calculation is credible."[86] He also challenged the use of an average on legal grounds because "we do not have a plaintiff, we have an average man, and there is no legal authority for awarding average damages to an average man."[87] The judge called this "an interesting issue" but rejected the argument.[88]

A second issue that was much debated was the matter of spatial substitution. ATTRANSCO's attorney raised this as a legal matter of the plaintiff's obligation to mitigate damages: "A person who

[82]Trial transcript, pp. 5458-9.
[83]Trial transcript, pp. 5458-9. He also tried to introduce a form of guilt by association, asking Hanemann: "You've told us about the theory of consumer surplus and you referred to Alfred Marshall. The theory of surplus value itself was invented by Karl Marx, wasn't it?...Did [Marshall] borrow the theory of surplus value from Karl Marx?" (Trial transcript, pp. 3123-4).
[84]Trial transcript, p. 547.
[85]Trial transcript, pp. 5344-45. On cross-examination, our response was "the consumers' surplus builds in an assumption that you will be doing something else with your time and your money, just not this activity" (trial transcript p. 3174).
[86]Trial transcript, p. 553. Our response in cross-examination was that this was an average over the different people using the beach and the different trips they took there. Consequently, "if the babe in arms did engage in beach recreation .. I'd apply the average to the babe in arms" (transcript, p. 3140).
[87]Trial transcript, pp. 3994, 4016-4019.
[88]Trial transcript, p. 4020.

has been damaged by the wrongful act of another is bound to exercise reasonable care and diligence to avoid loss and minimize damages and may not recover for damages that could have been prevented by reasonable efforts ... The issue we have here is substitution, and substitution is mitigation. If someone does not go to the beach, but could go to the beach, there's been a failure to mitigate." The judge called this "an interesting concept," but rejected it.[89] Dr. Dunford raised the issue of substitution as a matter of economics, and argued that substitution was very likely to have occurred because, in Orange County alone, there were many very good substitutes for the closed beaches. On cross-examination, however, he conceded that he did not have "a factual analysis or any sort of attendance analysis to support that [conclusion about substitution].[90] He also argued that an absence of substitution must mean that the consumers' surplus from beach recreation was lower than the incremental cost of going to a substitute site, thereby supporting his estimate of a low consumers' surplus from beach recreation.[91] [92]

With regard to the amount of recreation, Dr. Dunford's estimate was a loss of 264,000 beach recreation trips during the beach closure period.[93] He decided to "stay with" the figure of $2.30 per trip to value them, resulting in an estimate of a total recreational loss amounting to $607,200, as shown in Tables 1 and 3.[94]

The new element in Dr. Dunford's testimony dealt with an analysis by his staff of the PARVS travel cost data -- as opposed to the CV data -- for Southern California beaches. Dr. Dunford testified that his staff had recently analyzed our data set on one-day recreation trips by Southern California residents;[95] using OLS, Poisson regression and quantile regression and specific parametric functional forms (a different functional form with each estimation method), they had come up with estimates of consumers' surplus of about $5 per trip, compared to our estimates of $20-40 per trip. These conclusions were delivered with no advance notice to the State's attorneys and with no details of the

[89]Trial transcript, pp. 5117, 5120.
[90]Trial transcript, p. 4498.
[91]Trial transcript, pp. 4187-9. Dunford used Seal Beach and Doheny Beach as substitute sites in calculating the cost of diverted trips, and he assumed that the diverted trips largely avoided travel along Pacific Coast Highway. These assumptions, which we found implausible, made his estimate of the extra cost of diverted trips about half of ours.
[92]Hanemann pointed to some empirical evidence that we felt refuted this inference. On September 4, 1990 the parking charge at Bolsa Chica and Huntington State Beaches had been raised from $4 to $6. There was no change at that time in the parking fees at other beaches in the area. If beach users' mean WTP was only $2.30, as Dunford argued, the $2 increase would have greatly reduced the number of visits to the two state beaches. However, the attendance at these beaches showed no evidence of any reduction due to the increase.
[93] This was based on a prediction by Thurman (1996) of 340,000 trips during the closure period in the absence of an oil spill, using Ruud's non-linear specification (2) but with the lagged dependent variables omitted. For the number of recreation trips that did take place during the closure period, Dr. Dunford used the figure of 76,000 from Hanemann (1994). He did not use the higher figure from Hanemann's Exhibit 937, which would have been more favorable to his client, because of concerns he had with our 1996 beach count survey: "I felt it had flaws in it such that you could not get an accurate or reliable estimate of the actual number of people on the beach"(trial transcript, p. 4171). He did not elaborate on what these flaws were.
[94]He explained this as follows: "If this spill closed all the beaches in California for a year, I would say $2.30 is too low. But, in fact, this spill closed a few beaches for a few weeks in the winter, and I don't think that $2.30 is particularly low" (trial transcript, p. 4219).
[95]This analysis was conducted after Dr. Dunford's final deposition in August. He said then that between December and then his staff had worked mainly on re-analyzing Bell and Leeworthy's (1986) Florida travel cost data.

estimation. Without these details, we could not exactly replicate the TER analysis. However, we believe that most of the difference between their estimates and ours are due to three factors: (1) TER staff used a different functional form with each estimation method, and we believe that some selection bias was taking place; (2) our estimate was based on averaging the predicted consumers' per trip for each individual in the data set, while their estimate was based on the ratio of average predicted total consumers' surplus for each individual in the data set divided by the average predicted total number of trips per individual; (3) similarly, to account for multiple people in a party, we calculated the average of predicted consumers' surplus per person-trip, while they divided the average of total consumers' surplus by the average number of household trips *and* the average number of people per party. In both cases, we believe they had fallen into the error of estimating the mean of a ratio by taking the ratio of the means.

One of the more memorable experiences in life is to sit in the witness box before a jury, and have the other side's attorney confront you with an embarrassing error in your data. Hanemann had the pleasure of this experience during his cross-examination when ATTRANSCO's attorney confronted him with errors in 5 of the handwritten State Beach Monthly Visitor Attendance Reports. The total attendance data had been wrongly entered in the paid vehicle counts column and erroneously multiplied by the conversion factors that applied to paid vehicles; the effect was an eightfold error in each day's reported attendance during these particular months.[96] We had actually noticed and corrected this and other errors when we keypunched the data ourselves, prior to August 1994. Unfortunately, it had not been noticed when the data were keypunched at the Sacramento headquarters of DPR, and we had not noticed DP&R's oversight when we used the microfiche versions of the Monthly Visitor Attendance Reports that we obtained from DP&R headquarters. This was certainly an error, for which Hanemann took full responsibility. ATTRANSCO's lawyer hammered away at the fact that this could affect our entire analysis. Hanemann pointed out that it involved only 5 out of 160 months of beach data used in our statistical model, and would probably have only a small effect.

Following Hanemann's testimony, we immediately corrected the keypunch errors, together with some other minor errors that we found when re-checking the data. Paul Ruud re-estimated his models with the corrected data and produced new predictions of beach attendance during the period February 8 - March 31, 1990. We then revised our estimates of lost surfing and general beach recreation. We found that the net effect of the correction to the data was to *increase* the estimated loss of beach recreation by about 1%. The data errors had occurred during December and January, not the spill months of February and March (which partly explains why we had not detected them). Correcting the data errors had the effect of *lowering* predicted attendance in December and January, and *raising* it in February and March. The errors involved two State Beaches; but, because our statistical model included lagged attendance at neighboring beaches with generally negative coefficients, prediction errors tended to be self-canceling in the aggregate. Over prediction of attendance at one beach tended to induce a lower prediction of attendance at the neighboring beaches, and conversely. The overall effect was to minimize the bias that had been caused created by the data errors.

[96]The error was detected by ATTRANSCO's attorney on the eve of trial.

After some deliberation, the State's attorneys decided *not* to present this as rebuttal testimony at the end of the trial. While we deferred to the attorneys' judgment, it was a painful decision for us. They felt that, when the defense rested its case, the jury would be eager to wrap up the trial and would resent the days of additional testimony and cross-examination it could take to put on this evidence. They were also confident that there already was enough evidence in the record to show the jury what little difference the data errors made to our estimate of beach recreation loss. In addition, both Dr. Dunford and Professor Thurman had testified that they could not say whether the errors in the data would affect the amount of predicted attendance one way or the other.[97]

The jury deliberated for two and a half days before returning a verdict awarding the Trustees recreation damages in the amount of $12,753,071 plus a civil liability of $5,311,624.50 under the California Water Code, for a total of $18,064,695.[98] The next day, the *Los Angeles Times* quoted some jurors as saying that the jury had reached this figure by applying a 10% reduction to our estimate of lost beach recreation, to allow for the keypunch errors in our data; as an added caution, they had gone back to the Bell and Leeworthy (1986) estimate of $13.19 for consumers' surplus per beach trip, and then updated this to 1997 dollars. Essentially, they gave the State most of what it had asked for.[99]

Following the verdict, the judge awarded the Trustees an additional $4.37 million dollars in costs, expert fees, and attorney's fees. ATTRANSCO filed a motion for a new trial, which the judge denied. ATTRANSCO next filed an appeal of the verdict. Some months later, ATTRANSCO brought in a new attorney. On August 31, 1999 ATTRANSCO and the State agreed to a settlement in which ATTRANSCO paid to the plaintiffs a total of $16 million and the plaintiffs released ATTRANSCO from any and all claims. With that, the case was finally closed.

7. SOME LESSONS

The *American Trader* case illustrates several issues that can arise in the course of implementing the liability approach to the control of pollution which are sometimes overlooked in the environmental economics literature.

Unlike, say, the Microsoft case, this case did *not* involve a disagreement about economic theory. Here the experts on both sides agreed that consumers' surplus is the theoretically correct measure of the loss and that both the travel cost method and CV can be used to measure this. However, there was substantial divergence on the economic facts of the case. At trial, the plaintiff, the victim of the pollution, argued that there had been a loss of at least 618,000 trips, and probably a couple of hundred thousand more. The defendant, the polluter, argued that there had been a loss of at most 264,000 recreational trips, and up to one hundred thousand less. The victim argued that the lost

[97]Trial transcript p. 4081.

[98]*California Law Business* listed this as the tenth largest jury award in California in 1997 (3/23/98). The jury also found that ATTRANSCO had been negligent.

[99]After the trial, the judge complimented the attorneys on both sides for what he had found "a very pleasant and enjoyable trial. .. It was very well prepared, very professionally presented." (Trial transcript, pp. 5472-3).

trips should be valued at $15 per trip, and possibly as much as $23. The polluter argued that the lost trips should be valued at no more than $2.30 per trip, and probably some amount less. On both sides, these were sincerely held views, not just strategic positions adopted for purposes of bargaining. Nor were these differences peculiar to the trial. Except for the fact that we had additional information in 1997, our position at the trial was similar to what we had advised the State when it began settlement negotiations in 1991. And, while TER adopted a different position on several aspects of the benefits transfer in this case than in other cases in which it was engaged during the same period, we felt this was at the behest of its client, ATTRANSCO's attorney, whose position at the trial was similar to what it had been throughout settlement negotiations. The two parties saw basic facts regarding the damages very differently. This is not always recognized in economic models of bargaining and pollution control.

It is sometimes claimed that the benefits transfer approach provides a convenient solution when the requisite data are lacking. But, in this case there was considerable disagreement over basic issues such as whether or not beaches in Florida are "substantially dissimilar" from beaches in Southern California. If this benefits transfer is problematical, how much more so others! It is striking that, although both parties initially decided to use benefits transfer, as the trial approached they each felt compelled to undertake original research to re-analyze the data and re-estimate the models used in the benefits transfer studies -- both the Florida data from Bell and Leeworthy (1986), which was re-analyzed by TER, and the PARVS data, which both we and TER re-analyzed.

The case also illustrates how alternative analyses of data can produce quite different results. An example is the alternative models of daily beach attendance estimated by Ruud and Thurman; using exactly the same data, one model predicts an attendance of 530,00 trips and the other an attendance of around 300,000 trips. Some of the difference can be explained by professional judgments of statistical issues of the sort most economists are used to. However, we also believe that the daily attendance data we collected are genuinely difficult to model as time series. In the winter, beach attendance can switch very suddenly from many days of very low turnout to a bonanza day when crowds show up at the beach. The effects of changes in temperature may be quite non-linear, and there are also complex lag effects. Most consumer demand analysis in economics deals with monthly, quarterly or annual data; disaggregation to daily or weekly data can pose challenges which have not been widely experienced.

One might think that this case was just about using economic valuation in the courts. But, we would argue it was about something more general, namely using economic analysis in the courts. A significant part of the argumentation was about measuring the quantity of a commodity -- how many trips do people take to the beach in February? This is hardly different than measuring the consumption of any other commodity at a micro level, such as how many eggs are consumed in Orange County in February; anybody who has attempted it will know how difficult the measurement can be. Moreover, in our view the other main issue at stake in the trial -- what is the consumers' surplus per trip to the beach? -- is not substantially different than measuring other economic parameters such as the price elasticity of demand for eggs. Both measurements rely on models, and involve judgments about matters of model specification and estimation, that are inevitably open to dispute.

Looking back, it is striking to us how much of the case revolved around surveys and issues of data collection. Dunford et al. (1995) and Deacon and Kolstad (1995) criticized the PARVS and Florida survey data in Leeworthy and Wiley (1993) and Bell and Leeworthy (1986) because these involved the recall of trips over a 12-month period. Dr. Dunford criticized the 1990 RTI survey as being unreliable. And we criticized the PARVS CV survey for the poor design of the payment scenario. Moreover, the quality of the lifeguards' attendance data was a central issue from the very beginning, prompting Deacon and Kolstad to conduct an aerial survey of beaches in 1995 and RTI and us to conduct our ground-level beach count surveys in 1990 and 1996/97, respectively. In an adversarial setting one acquires an even greater respect for data than is common when writing papers for academic journals. A noteworthy example is this case is the errors in the Monthly Visitor Attendance Reports. We described these forms in mind-numbing detail at the beginning of this chapter. In the end, keypunch errors in five of those forms may have cost the State 10% of its claim, about $1.4 million, according to the account in the *Los Angeles Times;* under other circumstances, we believe the loss could have been significantly larger.

We draw two final conclusions from our experience in this case. First, details matter! Second, although the case was played out in an entirely non-academic setting, we found that it required a distinctly research-oriented approach in order to be credible with the judge and the jury. Issues of data collection and analysis played a central role in the four weeks of trial testimony, and these were as challenging as any academic research we have conducted.

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Table 1 ESTIMATES OF THE LOSS OF BEACH RECREATION TRIPS

	RECORDED ATTENDANCE	ADJUSTED ATTENDANCE	PREDICTED ATTENDANCE	ESTIMATED LOSS
	PLAINTIFF'S ANALYSIS*			
			HANEMANN (1994)	
DURING THE CLOSURE PERIOD	225,915	75,984	530,265	454,281
OUTSIDE THE CLOSURE PERIOD	683,033	629,537	908,523	278,986
ADDITIONAL SURFING LOSS				30,485
TOTAL BEACH LOSS				763,752
			TRIAL ESTIMATE*	
DURING THE CLOSURE PERIOD		119,135	565,154	446,019
OUTSIDE THE CLOSURE PERIOD		575,347	748,213	172,866
TOTAL BEACH LOSS				618,885
	DEFENDANT'S ANALYSIS			
			DUNFORD et al (1995)	
DURING THE CLOSURE PERIOD	225,915	116,622	297,992	181,370
OUTSIDE THE CLOSURE PERIOD				0
ADJUSTMENT FOR CHILDREN				-19,946
ADJUSTMENT FOR FOREIGNERS				-2,744
TOTAL BEACH LOSS				158,680
			TRIAL ESTIMATE **	
DURING THE CLOSURE PERIOD	226,000	76,000	340,000	264,000
OUTSIDE THE CLOSURE PERIOD				0
TOTAL BEACH LOSS				264,000

TABLE 2: UNIT VALUES FOR GENERAL BEACH RECREATION

				BY WHOM THE STUDY IS CITED					
STUDY	**BEACH AREA**	**METHOD**	**PER TRIP VALUE**	**Hanemann (1994)**	**Dunford et al. (1995)**	**Deacon & Kolstad**	**DOI French et al.**	**Hanemann (1997b)**	**Kolstad & Deacon**
			($ 1990)			**(1995)**	**(1996)**		**(2000)**
Bell & Leeworthy (1986)	Florida	TC	$13.19	X		X	X	X	X
Bell & Leeworthy (1986)	Florida	CV	$1.63			X			X
Brinkley & Hanemann (1978)	Boston	CV	$4.88			X			X
Bockstael, McConnell & Strand (1988)	Maryland	TC	$1.53-12.55			X			X
Curtis & Shows (1982)	Florida	CV	$3.00			X	X	X	
Curtis & Shows (1984)	Florida	CV	$5.73			X	X	X	
Dornsbusch (1987)	So. California	TC	$9.94-10.58			X	X	X	
Leeworthy & Wiley (1991)	New Jersey	TC	$21.05				X	X	
Leeworthy, Schruefer and Wiley (1991)	San Diego	CV	$1.00		X	X			
Leeworthy (1995)	San Diego	TC	$60.79					X	
Leeworthy, Schruefer and Wiley (1990)	San Onofre	CV	$4.33		X	X			
Leeworthy (1995)	San Onofre	TC	$57.31					X	
Leeworthy, Schruefer and Wiley (1990)	Cabrillo-Long Beach	CV	$1.95-2.17		X	X			
Leeworthy & Wiley (1993)	Cabrillo-Long Beach	TC	$8.16					X	
Leeworthy, Schruefer and Wiley (1990)	Santa Monica	CV	$1.15-2.33		X	X			
Leeworthy & Wiley (1993)	Santa Monica	TC	$18.36					X	
Leeworthy, Schruefer and Wiley (1990)	Leo Carillo	CV	$5.38		X	X			
Leeworthy & Wiley (1993)	Leo Carillo	TC	$51.94					X	
Leeworthy (1995)	Pismo Beach	TC	$26.20					X	
McConnell (1977)	Rhode Island	CV	$0.95-4.30			X			X
McConnell (1992)	Massachusetts	TC	$0.70-1.14			X			X
Meta Systems (1985)	Boston	TC	$13.60				X		
Moncur (1975)	Hawaii	TC	$1.07-4.18			X			X
Silberman and Klock (1988)	New Jersey	CV	$4.25			X			
Tyrrell (1982)	Rhode Island	TC & CV	$12.82				X		
US Army Corps of Engineers (1981)	Florida	TC	$2.47			X			
US Army Corps of Engineers (1993)	Florida	TC	$2.17			X			
RECOMMENDED UNIT VALUE ($1990)				$13.19	$2.30	<$5.00	$11.00	$15.00	$1.00-4.00

TABLE 3: ESTIMATES OF THE OVERALL RECREATION LOSS

		NO. OF TRIPS	PER TRIP LOSS (1990 $)	TOTAL LOSS (1990 $)
	PLAINTIFF'S ANALYSIS			
			HANEMANN (1994)	
(A)	LOSS DURING BEACH CLOSURE PERIOD			
	General beach recreation trips lost	454,280	$13.19	$5,991,953
	Surfing trips lost	30,485	$16.95	$516,721
	Private boating trips lost	22,074	$34.00	$750,516
	Sport fishing trips lost	1,860	$87.12	$162,043
	Whale watching and excursion trips lost	7,090	$45.00	$319,050
(B)	OUTSIDE CLOSURE PERIOD			
	General beach recreation trips lost	278,986	$13.19	$3,679,825
	TOTAL LOSS			$11,420,108
			HANEMANN (1997b)	
(A)	LOSS DURING BEACH CLOSURE PERIOD			
	General beach recreation trips lost	389,580	$15.00	$5,843,700
	Surfing trips lost	28,290	$18.75	$530,438
	Surfing trips diverted to substitute sites	28,148	$12.00	$337,776
	General beach recreation and surfing trips under adverse conditions	119,135	$3.00	$357,405
	Private boating trips lost	13,074	$40.00	$522,960
	Sport fishing trips lost	1,860	$83.00	$154,380
	Whale watching and excursion trips diverted	7,090	$12.00	$85,080
(B)	NET LOSS AFTER RE-OPENING, IN MARCH			
	General beach recreation trips lost	147,064	$15.00	$2,205,960
	Surfing trips lost	12,901	$18.75	$241,894
	Surfing trips diverted to substitute sites	12,901	$12.00	$154,812
	General beach recreation and surfing trips under adverse conditions	212,878	$3.00	$638,635
(C)	NET LOSS IN APRIL			
	General beach recreation and surfing trips under adverse conditions	370,000	$3.00	$1,110,000
	TOTAL LOSS			$12,183,040
	DEFENDANT'S ANALYSIS			
			DUNFORD et al. (1995)	
	LOSS DURING BEACH CLOSURE PERIOD			
	General beach recreation trips	158,680	$2.30	$365,403
	Credit for rubbernecker trips	109,164	$0.95	($103,257)
	TOTAL LOSS			$262,146
			DUNFORD EXHIBIT 2224	
	LOSS DURING BEACH CLOSURE PERIOD			
	General beach recreation trips lost	264,000	$2.30	$607,200
	TOTAL LOSS			$607,200

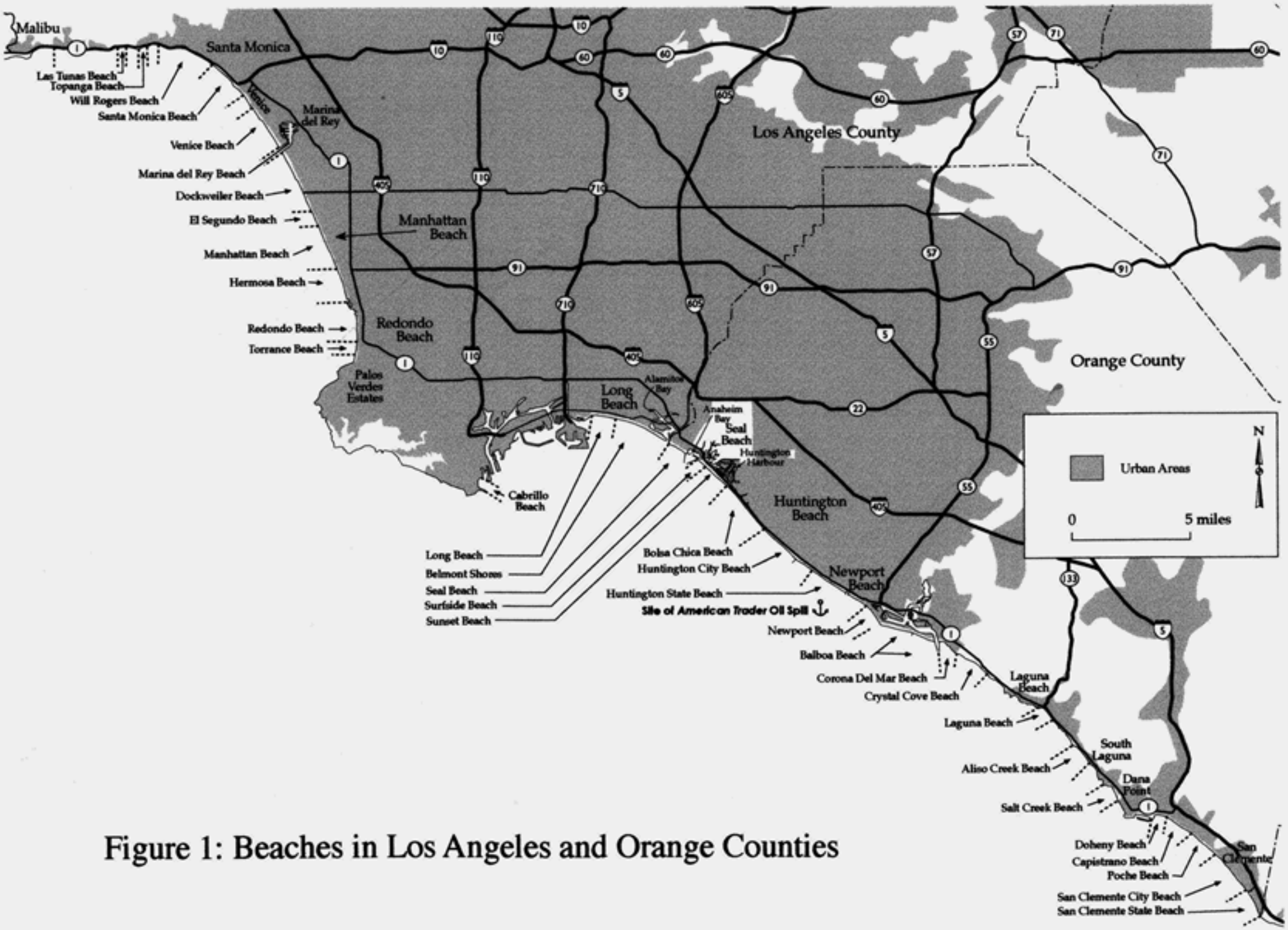

Figure 1: Beaches in Los Angeles and Orange Counties