Appendix 6-1

ESTIMATING POTENTIAL DEMAND FOR FRESHWATER RECREATION ACTIVITIES IN THE SACRAMENTO-SAN JOAQUIN RIVERS DELTA

1997 – 2020

Jason Plater
And
William W. Wade

Energy and Water Economics
810 Walker Street
Columbia, TN 38401

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Estimating Potential Demand for Freshwater Recreation Activities in the Sacramento-San Joaquin Delta Rivers: 1997-2020

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Estimating Potential Demand for Freshwater Recreation Activities in the Sacramento-San Joaquin Rivers Delta: 1997 - 2020

1. Model and Survey Data Base

This submittal provides an estimate of the potential demand in California for freshwater recreation activity through 2020, achieving the same purpose as our 1991 report. Our April 15, 1991, report "Projected Freshwater Recreation Demand Potential by County - 1990 - 2035" explains how we estimate the participation rates for recreation activities. This remains the model. Current estimated model coefficients are attached as Appendix A tables. Potential demand is defined in the recreation literature as a revealed preference by an individual reported in a survey completed in the home. A sample in the home is likely to intercept participants and non-participants, which means that the analytic methods are distinctly different from those that would apply to a sample of users intercepted at a destination or, to a sample of boat owners.

Potential demand can be labeled potential recreation participation days. The most consistent body of research[1] on Californian's recreation preferences, "Public Opinions and Attitudes on Outdoor Recreation in California" (hereafter "CIC study") tabulates adults who participate in the activity and labels the estimates a "conservative estimate since more than one adult household member may have participated in a given activity."

2. Estimating Methods

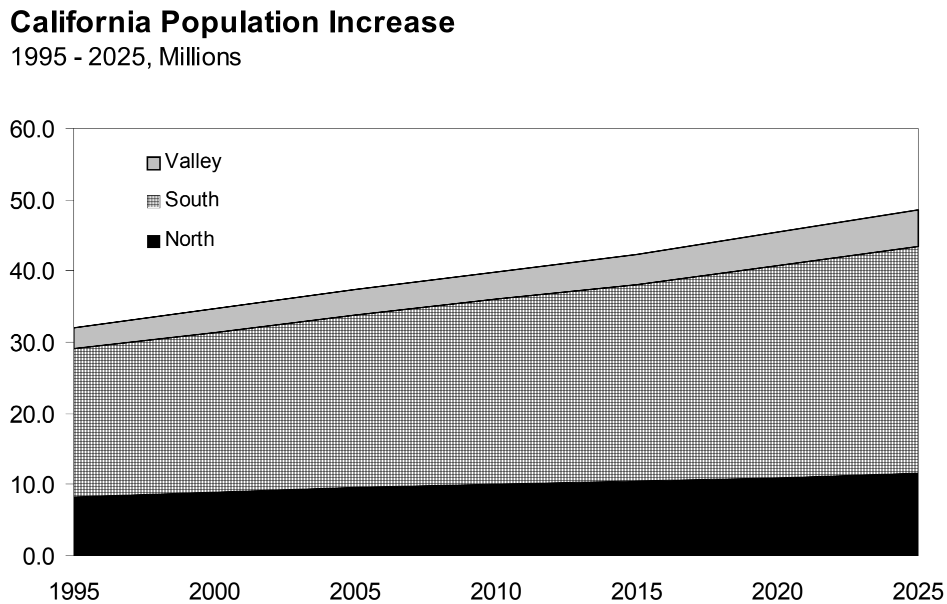
Potential demand for boating, fishing, and day use is estimated with long established econometric techniques. The methods described in Appendix A require two equations that work together to predict the probability that an individual will participate in an activity and, if yes, how many times in a year.

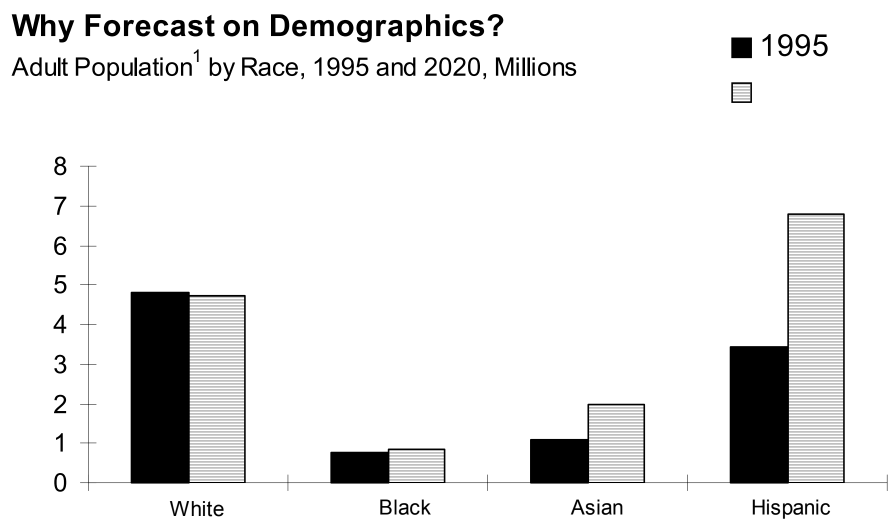
2.1 Modeling Demographic Determinants of Recreation Behavior

Models estimated from the CIC results are used to predict potential freshwater recreation participation days in each of California's counties. A 1997 estimate is provided along with forecasts for 2000, 2005, 2010, 2015 and 2020. Forecasting based on geographic and ethnic characteristics of the population (assuming these variables affect recreation preferences, which they do) is important in California due to the rapidly changing makeup of the state's population and where the growth in population is occurring. The first panel of Figure 1 shows that the majority of the population growth in the state over the next 25 years will occur in Southern California. Southern California's population will not only increase more than 40 percent by 2020, it will age and become more heavily Hispanic. Consequently, the recreation participation days revealed for a younger, whiter society in the CIC 1997 survey should not be expected to remain constant over the next 23 years.

[1] The data set for the current study is derived from the most recent update to the CIC survey, which was completed in 1997.

Southern California Population Growth by Major Ethnic Group

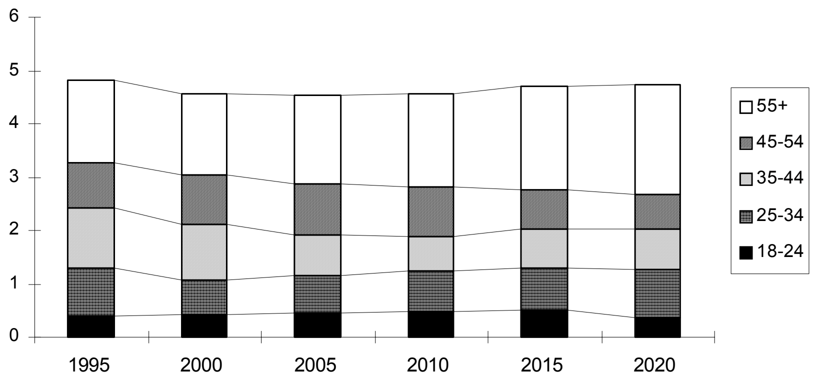




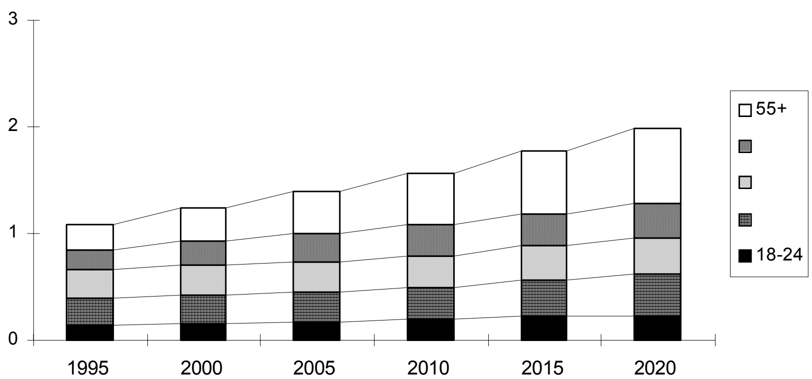
[1] SCAG forecasts of LA, Orange, Riverside, and San Bernardino Counties.

Distribution of income also may change; i.e., low-income whites were about 10 percent of whites in 1990, but low income Hispanics were about 19 percent of Hispanics. The percentage of high-income whites was about twice that of high income Hispanics. The changes in distribution of income have not been forecast by appropriate agencies and cannot be forecast by us for this project.

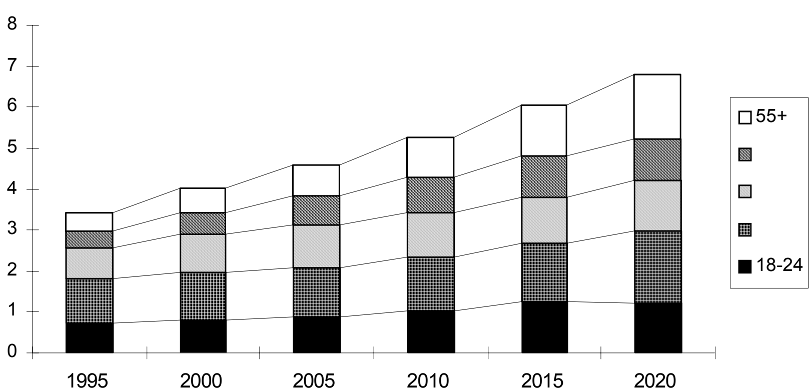
Southern California[1] White Adult Population
By Age Category, Millions



Southern California[1] Asian Adult Population
By Age Category, Millions



Southern California[1] Hispanic Adult Population
By Age Category, Millions



The CIC data set includes a rich array of demographic variables that allow us to discern any patterns of recreation behavior systematically related to gender, age, income, race, education, years of residence in the U.S., household size—and all combinations. We can "explain" more about recreation choices revealed in 1997 than we can forecast. For example, years of residency in the U.S. may be an important variable to explain immigrant recreation preferences revealed in the sample, but we cannot forecast "years in the U. S." attached to a segment of society. The forecast data are not available. So, we haven't used it in this exercise.

Appendix A shows the variables in the equations that remain after testing dozens of alternatives. These variables represent statistically significant characteristics of recreation behavior revealed in the CIC survey for demographic groups. The explanatory variables of the two equations that are used to predict the number of freshwater recreation trips will be discussed in a following section. Given the large possibilities of age/income/gender/ethnicity combinations, the relatively small number of variables in the equations that explain recreation preferences is the first research finding.

2.2 Avoidance of Double Counting

We consider the three primary demand attractors critical to the forecasting exercise to be:

- Boaters
- Anglers
- Day users

Camping is predicted in association with each of these primary attractors to avoid double counting. The CIC survey reveals a huge demand for camping.

A number of respondents participated in one or more activities. We want to predict trips and avoid double counting. Whether or not their responses count multiple activity days during one recreation trip is unknown. An activity day counts every activity during a day of recreation as a separate event. We must assign every activity day to a primary destination activity, while allowing respondents to make multiple trips for different activities. We formulated the following behavior assumption decision rules to reduce double counting.

Boaters:

We attempt to disentangle responses for power boating, skiing, and fishing to avoid double counting.

- If the respondent boats and fishes, we subtract the fishing days from boating.
- If the respondent boats and water-skis, we only count the skiing days.

Fishing

- Fishing trips are counted as reported.

Day Use

- The greater of picnicking or "use of open grass or turf areas" is reported.

The net result of this is that boating, skiing and fishing trips double counting is eliminated; all boat trips are uniquely tabulated and additive.

Day use trips are more problematic. While the freshwater recreation areas in the data set can be reasonably expected to capture the majority of boating and fishing days occurring in the state, the same cannot be said for day use. The CIC survey provides no realistic way to separate day use trips associated with freshwater recreation areas from those occurring at the thousands of local parks, beaches, state parks, open space preserves, etc., across the state. In previous research, we have attempted to separate out "destination" day use participation to freshwater recreation areas. In this case, we have not. Rather, we will rely on the CTC model's ability to match recreation demand with the facilities available at each recreation site to determine what fraction of the state's day use demand is accommodated at each.

3. Demographic Characteristics of Recreation Activity Participation

Demographic characteristics governing the probability that a person will participate in one of the activities, and with what intensity, are discussed by activity. The probabilities and mean number of participant trips statewide are shown on Table 1. If the demographic makeup and geographical distribution of the state's population were to remain constant in the next 20 years, the numbers in Table 1 would provide a sufficient basis for predicting future recreation demand. The participation rates and activity days would merely be multiplied by changes in population. Because the state is growing older and less demographically homogenous, and because population growth is expected to be concentrated in the South, simply multiplying the numbers in Table 1 times forecast population is not adequate. Such an approach would produce increasing levels of error in future forecasts as the population diverges from its 1997 make up. Instead, we subdivide the state's population into 120 demographic × 58 geographic segments. The 120 demographic bins are shown in Table 2; the 58 geographical bins represent each of the state's 58 counties. This leaves us with close to 7,000 demographic-geographic segments, each of which can have unique recreation participation characteristics[2]. To arrive at total statewide recreation

Statewide Participation Rates for Freshwater-Related Recreation Activities: 1997

	Boating	Fishing	Day Use
Participation Rate	35%	40%	85%
Participation Days Per Year			
All Individuals	4.5	6.7	24.4
Participants	12.7	16.9	28.8

[2] In each case, only a small fraction of demographic characteristics are found to be statistically significant in determining an individual's recreation activity. So although the model has the potential to track thousands of demographic-geographic bins, only a few differences emerge between them. Where participation rates are repeated between bins, it means that the bins' participation rates cannot be statistically differentiated.

demand, we multiply the participation rates and intensity of participation for each segment (from the CIC survey) times the number of individuals predicted to fall into each bin in future years (based on research by the CA Dept. of Finance's Demographic Research Unit). While parameter estimates by segment are held constant over the forecast period, the overall mean likelihood of participation in the future and the mean number of trips will change as the numbers of people in demographic segments change through time.

Table 2					
Demographic Segments Used to Estimate Particpation Rates					
1	M Wh Inc_H Age18_24	41	M As Age18_24	81	His Inc_L Age18_24
2	M Wh Inc_H Age25_34	42	M As Age25_34	82	His Inc_L Age25_34
3	M Wh Inc_H Age35_44	43	M As Age35_44	83	His Inc_L Age35_44
4	M Wh Inc_H Age45_54	44	M As Age45_54	84	His Inc_L Age45_54
5	M Wh Inc_H Age55_Pl	45	M As Age55_Pl	85	His Inc_L Age55_Pl
6	M Wh Inc_L Age18_24	46	M Bl Inc_H Age18_24	86	His Age18_24
7	M Wh Inc_L Age25_34	47	M Bl Inc_H Age25_34	87	His Age25_34
8	M Wh Inc_L Age35_44	48	M Bl Inc_H Age35_44	88	His Age35_44
9	M Wh Inc_L Age45_54	49	M Bl Inc_H Age45_54	89	His Age45_54
10	M Wh Inc_L Age55_Pl	50	M Bl Inc_H Age55_Pl	90	His Age55_Pl
11	M Wh Age18_24	51	M Bl Inc_L Age18_24	91	As Inc_H Age18_24
12	M Wh Age25_34	52	M Bl Inc_L Age25_34	92	As Inc_H Age25_34
13	M Wh Age35_44	53	M Bl Inc_L Age35_44	93	As Inc_H Age35_44
14	M Wh Age45_54	54	M Bl Inc_L Age45_54	94	As Inc_H Age45_54
15	M Wh Age55_Pl	55	M Bl Inc_L Age55_Pl	95	As Inc_H Age55_Pl
16	M His Inc_H Age18_24	56	M Bl Age18_24	96	As Inc_L Age18_24
17	M His Inc_H Age25_34	57	M Bl Age25_34	97	As Inc_L Age25_34
18	M His Inc_H Age35_44	58	M Bl Age35_44	98	As Inc_L Age35_44
19	M His Inc_H Age45_54	59	M Bl Age45_54	99	As Inc_L Age45_54
20	M His Inc_H Age55_Pl	60	M Bl Age55_Pl	100	As Inc_L Age55_Pl
21	M His Inc_L Age18_24	61	Wh Inc_H Age18_24	101	As Age18_24
22	M His Inc_L Age25_34	62	Wh Inc_H Age25_34	102	As Age25_34
23	M His Inc_L Age35_44	63	Wh Inc_H Age35_44	103	As Age35_44
24	M His Inc_L Age45_54	64	Wh Inc_H Age45_54	104	As Age45_54
25	M His Inc_L Age55_Pl	65	Wh Inc_H Age55_Pl	105	As Age55_Pl
26	M His Age18_24	66	Wh Inc_L Age18_24	106	Bl Inc_H Age18_24
27	M His Age25_34	67	Wh Inc_L Age25_34	107	Bl Inc_H Age25_34
28	M His Age35_44	68	Wh Inc_L Age35_44	108	Bl Inc_H Age35_44
29	M His Age45_54	69	Wh Inc_L Age45_54	109	Bl Inc_H Age45_54
30	M His Age55_Pl	70	Wh Inc_L Age55_Pl	110	Bl Inc_H Age55_Pl
31	M As Inc_H Age18_24	71	Wh Age18_24	111	Bl Inc_L Age18_24
32	M As Inc_H Age25_34	72	Wh Age25_34	112	Bl Inc_L Age25_34
33	M As Inc_H Age35_44	73	Wh Age35_44	113	Bl Inc_L Age35_44
34	M As Inc_H Age45_54	74	Wh Age45_54	114	Bl Inc_L Age45_54
35	M As Inc_H Age55_Pl	75	Wh Age55_Pl	115	Bl Inc_L Age55_Pl
36	M As Inc_L Age18_24	76	His Inc_H Age18_24	116	Bl Age18_24
37	M As Inc_L Age25_34	77	His Inc_H Age25_34	117	Bl Age25_34
38	M As Inc_L Age35_44	78	His Inc_H Age35_44	118	Bl Age35_44
39	M As Inc_L Age45_54	79	His Inc_H Age45_54	119	Bl Age45_54
40	M As Inc_L Age55_Pl	80	His Inc_H Age55_Pl	120	Bl Age55_Pl

Key to Abbreviations:

M	Male	Inc_L	Low Income
Wh	White	Inc_H	High Income
His	Hispanic		
As	Asian/Pacific Islander		
Bl	Black		

3.1 Probability of Participation in a Recreation Activity

This section develops the model to estimate household participation rates and presents the results for freshwater fishing, power boating and water skiing, and day use. Power boating and water skiing were combined to be a single activity to increase sample size for the estimation.

Recreation participation days for fishing, boating/skiing, and day use were estimated using a technique first proposed by Cragg (1971). Cragg's model is a generalization of Tobin's tobit model (1957) and, like tobit estimation, is designed to avoid the bias implicit in ordinary least squares[3] (OLS) estimation when the dependent variable is truncated or censored. OLS is not recommended for modeling participation days when non-participation is a common occurrence because the parameter estimates are biased, and the resulting participation estimates can be negative.

Cragg-class models and the tobit model partition the choice to participate in a given activity into two parts. First, the model estimates whether someone will participate or not in a given activity. Second, given that someone decides to participate, the model estimates how much that person will participate. In modeling this sequential choice the tobit model assumes that the choice to participate is governed by the same variables that govern how much one participates. The tobit model further imposes the restriction that the parameters of these variables be equal across the two choice equations. Cragg-class models relax these two restrictions. These models assume that the choice to participate in an activity may be influenced by factors other than those that affect the intensity of participation. Should the same variables influence both the decision to participate and the intensity of participation, they are not restricted to influence them by the same degree.

The Cragg-class model of freshwater recreation is estimated in two steps. First the probability that an individual will choose to participate in a freshwater recreation activity is estimated using discrete choice econometric techniques. Second, given that a person chooses to participate in a freshwater recreation activity, the rate of participation (days per year) is estimated using OLS on the log of participation.[4] Therefore, the model yields a conditional and unconditional expectation of participation. The conditional expectation is the expected level of participation of actual participants whereas the unconditional expectation is the expected level of participation of the population—participants and non-participants. The demographic and recreation opportunity index variables found to be important in estimating participation rates for freshwater boating, fishing, and day use are presented in Appendix A.

A set of equations also is used to predict the number of times a person will participate in the activity, given that she identifies herself as a participant. These answers are derived from the responses to the general question: How many times did you do it last year?

The equations that estimate intensity are ordinary least squares type equations estimated over statistically significant demographic predictors of frequency of participation revealed by the data. As with the PROBIT equations, dozens of demographic combinations to explain frequency were tried. The variables that proved to add to explanatory power are listed on LS tables in Appendix

[3] G.S. Maddala's Limited-dependent and qualitative variables in econometrics (1983) provides a good explanation as to why OLS is biased when the data are truncated or censored.

[4] As explained in Appendix A if the log of participation is assumed to be normally distributed then participation will have an asymmetric distribution bounded below by zero and mass centered near zero. An example of this distribution is shown in Figure A-1. A distribution such as this conforms to empirical evidence which shows that many, if not the majority of households, do not participate in an activity and the majority of households that do participate only do so a few days per year.

B. Interpretation of the OLS coefficients is straightforward: positive signs add to the number of trips generated; negative signs subtract. The equation is estimated in semi-logs. So the coefficients ultimately predict trips as a number "*e* to the intercept term plus the coefficient."

The adjusted R-Squareds are typically low when trying to explain behavior with demographic variables alone. They range below 10 for our equations even though the explanatory variables are statistically significant. While these demographic categories matter, something else matters more to people's recreation choice behavior.

3.2 Boating Participation Estimates

Participation Rate

We found significant effects on participation in boating activities in all the demographic variables tracked in the model: by age, ethnicity, education, income, and geography. All these variables show the expected signs.

The results conform to what one might expect *a priori*:

- Young adults boat more while older people (51+) boat much less often;
- Asians and Hispanics boat much less than whites and, to a lesser extent, blacks;
- Those with higher education boat more often than those with lesser years of education;
- Boating is an activity more often engaged in by the wealthy, and much less by the poor; and
- People living in the northern part of the state are more likely to be boaters than those in the South, and freshwater boaters are more likely to be inland than near the coast.

Virtually all of the findings point to an increase in boating in the Delta that will be slower than the general rate of population growth in the state. As the state's population becomes more Hispanic and Asian, older, arguably more concentrated in lower income categories, and more concentrated in the South; the fraction of the population represented by the typical boater, namely white, young, well educated and wealthy, and living in Northern California, will represent an ever-smaller percentage of the population.

Participation Intensity

Among boaters, the region of the state where the boater resides appears to have greater influence on how often he/she boats than any personal characteristics. Not surprisingly, boaters who live in counties with more freshwater recreation opportunities tend to boat more often. The only significant demographic variable is for Hispanics, among whom boaters pursue the activity less often than others. These findings are not surprising: among those who have invested in the equipment necessary to become a boater, geography is the most significant indicator of how often they use their boats.

3.3 Fishing Participation Estimates

Participation Rate

Many demographic and geographic determinants of whether people engage in fishing were found, though not to the same extent as for boating. The strongest determinant of whether a Californian fishes is whether he lives in the Northern or mountainous regions of the state. Low income individuals tend to fish less. However, both participation and intensity of participation decrease as educational attainment increases. Those from larger households tend to be more likely to fish, though this finding is irrelevant to forecasting as future estimates on household size are not available. And, of course, men are more likely to fish than women.

Participation Intensity

Similar to boating, geographical location is a better indication of how often anglers fish than demographic characteristics. Those from mixed ethnic and black households fish somewhat more often. The number of days spent fishing decreases with education, although the only statistically significant finding was among those who have pursued graduate school. Even these results must be omitted from final predictions because we have no ability to forecast educational attainment into the future.

3.4 Day Use Participation Estimates

Day use activities are the most difficult activities to forecast using these models. First, the definition of day use encompasses many outdoor activities from picnicking to simply relaxing out of doors. Second, these activities can be engaged in practically anywhere—no body of water is required as there is for fishing or boating. Lastly, activities meeting the definition of day use are ubiquitous. Almost everyone engages in day use activities, and differences among people's participation reflects personal taste more than broad differences between, say, whites and Hispanics.

Nonetheless, some significant demographic determinants of day use participation could be teased from the data. Interestingly, in the CIC data set the most significant demographic variable was an indication that Hispanics generally participate is less outdoor recreation than the benchmark young, white person. This result seems contradictory to both prior research and anecdotal evidence that Hispanics are frequently participants in outdoor picnicking activities. An expected finding is that young people engage in day use activities more than older citizens. The fraction of Asians who participate in day use activities is not significantly different from the rest of the population, although those who do appear to do so somewhat less frequently than the population at large.

4. Results: Predicted Potential Demand for Freshwater Recreation Activities.

Predicted potential demand for recreation activities is shown by geographic region 1997, 2000, 2005, 2010, 2015, and 2020 in Table 3. The results show a large potential demand for the activities—more so, perhaps, than the state's freshwater recreation areas could ever accommodate, and far more than is documented in the CIC report using the same data set. Why are the estimates so different? The cause mostly turns out to be with CIC's post survey processing of the data. Careful reading of the CIC 1997 report and a discussion with CIC reveals

Table 3A
Estimated Boating Recreation Demand in California
1997 - 2020 by Geographic Region

	North Coast	North Mountain	North Valley	Central Coast	Central Mountain	Central Valley	Bay Area	South Coast	S. Desert/ Mtn	South Valley	LA/ San Diego	State Total
Participants												
1997	252,327	110,713	84,543	170,018	185,404	543,043	1,713,914	268,166	32,620	304,987	3,260,504	6,926,238
2000	267,178	119,482	89,331	178,542	207,566	574,852	1,752,571	275,891	35,016	320,716	3,341,071	7,162,214
2005	287,498	131,118	99,711	190,432	240,412	625,133	1,794,646	289,020	40,790	347,533	3,454,666	7,500,959
2010	302,974	139,577	108,429	203,423	267,330	675,615	1,829,915	305,103	46,873	374,859	3,596,443	7,850,541
2015	312,151	145,232	115,100	213,540	287,722	713,537	1,824,437	318,987	52,629	397,499	3,677,453	8,058,287
2020	323,318	152,040	123,152	223,660	308,369	753,265	1,816,917	335,394	59,867	423,081	3,771,383	8,290,446
Visitor Days - Millions												
1997	3.3	1.4	1.0	2.6	2.2	4.6	20.5	2.6	0.2	4.7	31.0	74.1
2000	3.5	1.5	1.0	2.7	2.5	4.9	20.9	2.6	0.2	4.9	31.5	76.2
2005	3.7	1.7	1.1	2.9	2.9	5.3	21.2	2.7	0.2	5.2	32.2	79.2
2010	3.9	1.8	1.2	3.0	3.3	5.7	21.5	2.9	0.3	5.6	33.1	82.1
2015	4.0	1.8	1.3	3.1	3.5	5.9	21.3	3.0	0.3	5.8	33.3	83.4
2020	4.2	1.9	1.4	3.1	3.8	6.2	21.1	3.1	0.3	6.1	33.7	84.9

Table 3B
Estimated Fishing Recreation Demand in California
1997 - 2020 by Geographic Region

	North Coast	North Mountain	North Valley	Central Coast	Central Mountain	Central Valley	Bay Area	South Coast	S. Desert/ Mtn	South Valley	LA/ San Diego	State Total
Participants												
1997	219,827	164,934	137,315	172,974	192,023	806,733	1,642,035	233,739	39,865	441,716	4,597,243	8,648,404
2000	233,295	178,449	145,723	182,272	214,658	861,136	1,699,672	241,977	42,895	467,563	4,764,056	9,031,695
2005	255,610	199,106	165,767	198,190	250,563	958,865	1,786,454	257,944	50,377	517,708	5,025,384	9,665,968
2010	275,331	215,692	184,292	217,184	281,678	1,063,434	1,874,254	278,795	58,677	573,752	5,364,071	10,387,160
2015	289,652	227,362	199,626	234,606	306,305	1,155,748	1,936,125	299,393	66,620	626,423	5,670,912	11,012,772
2020	304,743	239,024	217,958	254,265	330,280	1,257,520	2,015,006	323,754	76,569	687,779	6,076,356	11,783,255
Visitor Days - Millions												
1997	3.4	2.5	2.1	2.7	9.1	12.3	25.2	3.6	0.6	6.8	70.7	138.9
2000	3.6	2.7	2.2	2.8	10.1	13.2	26.1	3.7	0.7	7.2	73.2	145.5
2005	3.9	3.0	2.5	3.1	11.8	14.6	27.4	4.0	0.8	8.0	77.1	156.2
2010	4.2	3.3	2.8	3.3	13.3	16.2	28.7	4.3	0.9	8.8	82.2	168.1
2015	4.4	3.5	3.0	3.6	14.5	17.7	29.6	4.6	1.0	9.6	86.9	178.4
2020	4.7	3.6	3.3	3.9	15.6	19.2	30.8	5.0	1.2	10.6	93.1	191.1

Table 3C
Estimated Day Use Recreation Demand in California
1997 - 2020 by Geographic Region

	North Coast	North Mountain	North Valley	Central Coast	Central Mountain	Central Valley	Bay Area	South Coast	S. Desert/ Mtn	South Valley	LA/ San Diego	**State Total**
Participants												
1997	489,524	186,562	240,778	372,530	282,211	1,427,093	3,586,891	776,142	85,320	881,552	9,934,520	18,263,122
2000	519,487	201,705	255,603	392,402	315,626	1,522,941	3,708,139	803,996	91,780	931,438	10,265,578	19,008,695
2005	565,779	223,711	289,625	424,605	367,106	1,690,638	3,884,545	856,305	107,544	1,025,643	10,780,167	20,215,668
2010	604,121	240,323	320,103	462,159	410,184	1,865,255	4,057,849	921,630	124,591	1,128,072	11,459,021	21,593,309
2015	629,777	251,430	344,607	494,662	443,292	2,012,208	4,156,108	982,970	140,834	1,221,142	12,023,117	22,700,146
2020	657,884	263,054	373,804	528,986	475,819	2,169,954	4,269,870	1,052,389	160,825	1,324,258	12,704,380	23,981,222
Visitor Days - Millions												
1997	11.7	4.5	5.7	9.1	6.7	34.2	81.9	18.9	2.1	21.8	239.2	435.6
2000	12.3	4.8	6.0	9.5	7.4	36.1	83.1	19.3	2.3	22.9	244.4	448.0
2005	13.2	5.3	6.7	10.1	8.6	39.3	84.3	20.2	2.7	24.9	251.2	466.4
2010	13.9	5.7	7.4	10.9	9.5	42.8	85.7	21.5	3.1	27.1	262.7	490.3
2015	14.4	5.9	7.9	11.6	10.3	45.8	86.3	22.9	3.5	29.3	272.9	510.8
2020	14.9	6.2	8.5	12.4	11.0	49.1	87.2	24.4	4.0	31.7	286.3	535.7

the following differences in methods:

1. CIC's describes its estimates as "household participation days" and inflates its sample results by the number of households in the state rather than by individuals. However, a reading of the question that elicits participation:

   "for each activity, please give us your best estimate of the total number of days during which **you** participated in that activity during the last 12 months. Include even those days when you did the activity for only a short period of time. [emphasis added]"

   specifically asks the individual about his/her own participation and not the sum of everyone in their household. Inflating on adult individuals rather than households would approximately double CIC's estimated participation days.

2. CIC's results are more disaggregated. For example, CIC reports separate results for boating and water skiing, whereas we attempt to develop estimates of overall boating.
3. CIC's participation estimates are derived from a mail survey derivative of their initial 2000 telephone samples. The CIC mail survey had 802 respondents statewide. We utilize a subset of 643 responses, which had no missing data in any of the demographic categories used for forecasting. There is no reason to expect, however, that the 159 observations excluded from out data set represented lower-than-average participation rates. [Either way, this is "thin" coverage, which should be rectified in the 2002 survey.]
4. CIC's sampling approach is designed to stratify county sampling to assure coverage of the small counties for statewide representation. As a result, large counties, and the large population base in Southern California, are underrepresented in CIC's estimates.
5. We use a formula that more accurately (or transparently, at least) estimates total and average activity participation days. Our estimation method multiplies probability of participating (for various demographic/ethnic groups) times number of trips for participants times population

of adults in the demographic group to estimate trips for an activity arising from a county. CIC double-discounts probability of participation, i.e.:

Foster Approach:

Statewide participation days = participation rate × avg. days per participant

CIC Approach

Statewide participation days = participation rate^2 × avg. days per participant

CIC estimates are low and biased against those activities in which smaller percentages of society participate. E.g., water skiing, hunting, down hill skiing, and other activities with 10 - 30 percent participation rates are double-discounted with the 10 - 30 percent number, making the estimates 90 to 70 percent lower, while those like walking with an 85 percent participation rates are only discounted the second time by 85 percent, making the estimate only 15 percent lower. Discounting the estimate of trips by the probability of participation a second time is not intuitively obvious, and seems to be an error. While the survey results indicate that the number of trips people said they made could never occur in the state if the sample is truly representative, we remain unconvinced that the technique employed by CIC to discount the results is satisfactory.

Example: Freshwater Fishing

CIC Estimates total state demand as follows:

0.373 probability of fishing * 16.3 freshwater fishing days if angler * .373 again * 11.5 million households = 26.1 million freshwater fishing trips statewide.

Eliminating the double discounting, the corrected CIC fishing estimate is 69.9 million adult angling days statewide, blowing up on households, or close to 120 million days blowing up on adults. The CIC statewide angling estimates, using our methods, would be closer in line with our estimate of 139 million visitor days.

5. Conclusion: Potential Demand Results Reasonable for Intended Purpose, But Have Limited Applicability to Other Studies

If the ultimate goal of this modeling exercise to estimate the number of recreation days that occur in California, the results achieved here could not be considered a success. The numbers are simply too large to be believed. However, in the context of the ultimate goal of forecasting visitation to freshwater recreation areas, the shortcomings of the participation data are less significant. The CTC model is calibrated to actual visitation data from recreation facilities; the level of “demand” is automatically scaled down to match actual arrivals. More important from the CTC modeling perspective is that the “demand” inputs are consistently measured and that as the population’s size and demography changes, our method discerns the relative changes in demand that go along with the new makeup of the population.

Our potential recreation day estimates are a reasonable estimate of people’s desired behavior. This doesn’t mean that every one of these trips will materialize. CIC devotes a great deal of attention in their study to Unmet Demand, even with their discounted estimates. There is a huge unmet demand for freshwater recreation in California, and especially in Southern California.

Appendix A

Table 1

PROBIT // Dependent Variable is BOATNOTFISH_YN
Date: 11/30/00 Time: 20:47
Sample: 1 643
Included observations: 643
Convergence achieved after 3 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.361388	0.087139	-4.147260	0.0000
INC_L	-0.346162	0.163033	-2.123262	0.0341
INC_H	0.224173	0.131503	1.704705	0.0887
AGE51_PL	-0.639812	0.138765	-4.610745	0.0000
ASIA	-0.645913	0.350369	-1.843522	0.0657
HIS	-0.403969	0.180187	-2.241940	0.0253
RECLKPCT	0.092662	0.044674	2.074191	0.0385
R_NORTH	0.286594	0.127303	2.251268	0.0247

Log likelihood	-389.9758
Obs with Dep=1	227
Obs with Dep=0	416

Variable	Mean All	Mean D=1	Mean D=0
C	1.000000	1.000000	1.000000
INC_L	0.143079	0.092511	0.170673
INC_H	0.200622	0.251101	0.173077
AGE51_PL	0.211509	0.123348	0.259615
ASIA	0.031104	0.013216	0.040865
HIS	0.115086	0.070485	0.139423
RECLKPCT	0.954318	1.179229	0.831590
R_NORTH	0.244168	0.308370	0.209135

Appendix A

Table 2

PROBIT // Dependent Variable is FISHING_YN
Date: 11/30/00 Time: 21:41
Sample: 1 643
Included observations: 643
Convergence achieved after 2 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.420574	0.073869	-5.693500	0.0000
INC_L	-0.199410	0.149436	-1.334418	0.1825
M_26_35	0.467120	0.189875	2.460151	0.0142
M_36_50	0.316434	0.139372	2.270432	0.0235
R_CENMTN	0.466563	0.248662	1.876295	0.0611
R_CENVALLEY	0.242704	0.152179	1.594855	0.1112
R_NOMTN	0.646543	0.203736	3.173440	0.0016
R_NOVALLEY	0.259716	0.214953	1.208244	0.2274
R_SOCOAST	-0.370660	0.224751	-1.649204	0.0996

Log likelihood	-416.3496
Obs with Dep=1	254
Obs with Dep=0	389

Variable	Mean All	Mean D=1	Mean D=0
C	1.000000	1.000000	1.000000
INC_L	0.143079	0.118110	0.159383
M_26_35	0.076205	0.102362	0.059126
M_36_50	0.161742	0.196850	0.138817
R_CENMTN	0.043546	0.059055	0.033419
R_CENVALLEY	0.130638	0.153543	0.115681
R_NOMTN	0.068429	0.102362	0.046272
R_NOVALLEY	0.059098	0.066929	0.053985
R_SOCOAST	0.065319	0.039370	0.082262

Appendix A

Table 3

PROBIT // Dependent Variable is DAYUSE_YN
Date: 11/28/00 Time: 20:01
Sample: 1 643
Included observations: 643
Convergence achieved after 3 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.117184	0.084145	13.27695	0.0000
HIS	-0.481622	0.180160	-2.673305	0.0077
AGE26_35	0.384077	0.179925	2.134651	0.0332
AGE51_64	-0.300080	0.152015	-1.974012	0.0488
AGE65_PL	-0.909417	0.360892	-2.519912	0.0120

Log likelihood	-263.2241
Obs with Dep=1	545
Obs with Dep=0	98

Variable	Mean All	Mean D=1	Mean D=0
C	1.000000	1.000000	1.000000
HIS	0.115086	0.102752	0.183673
AGE26_35	0.203733	0.220183	0.112245
AGE51_64	0.191291	0.177982	0.265306
AGE65_PL	0.020218	0.012844	0.061224

Table 4

LS // Dependent Variable is LOG(BOATNOTFISH)
Date: 11/30/00 Time: 20:54
Sample: 1 227
Included observations: 227

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.722125	0.104515	16.47728	0.0000
R_CENCOAST	0.516522	0.396538	1.302578	0.1941
R_CENMTN	-0.638215	0.339524	-1.879735	0.0615
R_CENVALLEY	-0.407149	0.223741	-1.819739	0.0702
R_SOVALLEY	0.510710	0.384515	1.328191	0.1855
R_SODESMTN	-0.803267	0.456438	-1.759862	0.0798
HIS	-0.784382	0.290770	-2.697600	0.0075
RECLKPCT	0.179720	0.059328	3.029290	0.0027

R-squared	0.092945	Mean dependent var	1.806408
Adjusted R-squared	0.063952	S.D. dependent var	1.122502
S.E. of regression	1.086016	Akaike info criterion	0.199637
Sum squared resid	258.2951	Schwarz criterion	0.320341
Log likelihood	-336.7579	F-statistic	3.205801
Durbin-Watson stat	2.053596	Prob(F-statistic)	0.002971

Appendix A

Table 5

LS // Dependent Variable is LOG(FISHING)
Date: 11/30/00 Time: 22:47
Sample(adjusted): 28 253
Included observations: 38
Excluded observations: 188 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.811592	0.274065	6.610089	0.0000
SEX	0.212351	0.399158	0.531998	0.5982
R_CENMTN	-0.014436	0.879702	-0.016410	0.9870
AGE65_PL	1.589606	1.240422	1.281504	0.2087

R-squared	0.049368	Mean dependent var	1.947663
Adjusted R-squared	-0.034511	S.D. dependent var	1.189416
S.E. of regression	1.209766	Akaike info criterion	0.480155
Sum squared resid	49.76017	Schwarz criterion	0.652533
Log likelihood	-59.04261	F-statistic	0.588559
Durbin-Watson stat	2.110921	Prob(F-statistic)	0.626699

Appendix A

Table 6

LS // Dependent Variable is LOG(DAYUSE)
Date: 11/30/00 Time: 22:43
Sample: 1 545
Included observations: 545

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.641185	0.058418	45.21164	0.0000
AGE51_64	-0.344705	0.135719	-2.539847	0.0114
AGE65_PL	-0.714470	0.461073	-1.549580	0.1218
ASIA	-0.494342	0.282673	-1.748812	0.0809

R-squared	0.020898	Mean dependent var	2.553423
Adjusted R-squared	0.015469	S.D. dependent var	1.219523
S.E. of regression	1.210054	Akaike info criterion	0.388642
Sum squared resid	792.1484	Schwarz criterion	0.420207
Log likelihood	-875.2264	F-statistic	3.849033
Durbin-Watson stat	1.993052	Prob(F-statistic)	0.009587

6. RECREATION BENEFITS FOR CALIFORNIA RESERVOIRS: A MULTISITE FACILITIES-AUGMENTED GRAVITY TRAVEL COST MODEL

Executive Summary

This section describes the estimation process for boating, fishing, and swim/picnic visitation to the Delta for 1997 and in 5-year increments from 2000 through 2020. The results over all Delta regions are depicted in Figure 1.

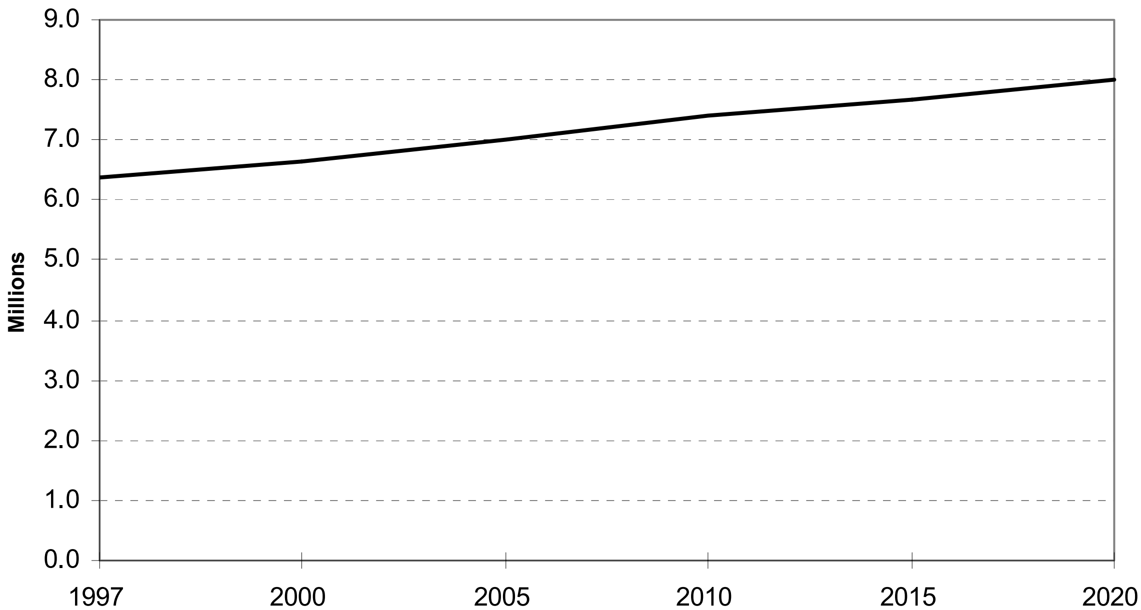


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Figure 1. Annual Visitation Forecasts to Delta 1997 - 2020, Visitor Days

Delta boating, fishing, and day use visitation is estimated at 6.4 million visitor days for 1997, the year for which the baseline model is benchmarked. Visits to the Delta will rise to over 8 million visitor days by 2020, a 25 percent increase over the period. These estimates are somewhat lower than our 1991 estimates of Delta visitation using the same modeling approach[5].

6.1 Freshwater Recreation in California

Californians enjoy a wide variety of outdoor recreation activities. Much of this occurs at reservoir sites in the form of camping, boating, water skiing, fishing, picnicking, and swimming. The waterflows of the Sacramento-San Joaquin Rivers watershed support over 25 million visitor-

[5] Recreation Forecasts and Benefit Estimates for California Reservoirs: Recalibrating the California Travel Cost Model: Report to the Joint Agency Recreation Committee. Spectrum Economics. 1991. The analytical approach and much of the language in this document are borrowed from this report.

days annually of recreation within the Delta, and upstream and downstream of the Delta in the reservoirs of the State Water Project (SWP), the Bureau of Reclamation's Central Valley Project (CVP), and the Army Corps of Engineers (COE). Without the water projects to distribute water from Northern California, few freshwater recreation opportunities would exist for Southern Californians. In effect, the projects extend freshwater recreation opportunities to Southern California residents, and supplement the natural mix of freshwater sites in Northern California.

This section describes the estimation of a gravity travel cost model for recreation uses of the waterflows of the Sacramento-San Joaquin Rivers within the Delta and at the SWP, CVP and COE reservoirs. Section 2 discusses the travel cost model, data and methods. Section 3 summarizes model results.

6.2 Travel Cost Recreation Demand Models

The rising value of society's scarce natural resources in conjunction with increasing real incomes and leisure time has been matched by state and federal laws to protect these resources. Economists have developed methods and tools to value and prioritize those protection efforts. The travel cost (TC) model is one important tool that is used to estimate recreation demand and value natural resources.

Travel cost recreation demand models (TC Models) are derived from a number of conditions usually observed in consumers' behavior, notably that consumers act to maximize their utility, subject to budget constraints. A number of technical conditions must be met to assure this linkage. Cross-sectional data for a system of freshwater recreation sites in California provide the basis to estimate a recreation demand model for recreation within the Delta, and at CVP, SWP and COE reservoir locations upstream and downstream of the Delta. A large part of the system of California freshwater recreation destinations, including most of those supplied by water from the Delta watershed, are included in the data set. The Delta and the reservoirs provide very similar recreation services. Eighty-three freshwater recreation destinations are tabulated with visitation data and variables that describe the costs and attributes of the sites. The model estimates freshwater recreation demand from 58 counties of California for a subset of these 83 lakes, reservoirs, and six separate sections of the Delta. These destinations account for tens of millions of visitor arrivals annually. Table 1 shows the sites included in our database. The majority of these sites are used for model estimation. For some sites, however, the model cannot adequately capture a particular characteristic of the site—Lake Elsinore’s widely fluctuating water levels in recent years, for example—and such sites are removed form the data set used for estimation.

Table 1. Recreation Destinations Included in CTC Data Set

Lake Mendocino	Lake Webb & Lake Evans
Lake Pillsbury	Pyramid Lake
Lake Britton	Big Bear Lake
Shasta Lake	Silverwood Lake
Black Butte Lake	Lake Havasu
Lake Almanor	Lake Skinner
Antelope Lake	Isabella Lake
Frenchman Lake	Lake Casitas
Lake Davis	Lake Piru
Little Grass Valley Lake	Castaic Lake
Bullards Bar Reservoir	Lake Perris
Stampede Reservoir	Puddingstone L.-Bonelli
Englebright Reservoir	Contra Loma Reservoir
Donner Lake	East Park Reservoir
Boca Reservoir	Keswick Reservoir
Lake Natoma	Sly Park/Jenkinson L.
Folsom Lake	Red Bluff Lake
Union Valley Reservoir	Stony Gorge Reservoir
Lake Sonoma	Sugar Pine Reservoir
Bethany Reservoir	Martis Creek
Del Valle Reservoir	Lake Tahoe
New Hogan Lake	Camanche Reservoir
New Melones Lake	Pardee Lake
Don Pedro Lake	Clear Lake
Bass Lake	Camp Far West Lake
Pine Flat Lake	L.Clementine-Auburn
Shaver Lake	Whiskeytown Lake
Success Lake	Indian Valley Res.
Lewiston Lake	Lake Amador
Trinity Lake	Lake Crowley
Butt Valley Reservoir	Lake Elsinore
Eagle (Lassen National Forest)	Salton Sea
Lake Oroville	San Antonio Reservoir
French Meadows Res.	Lake Nacimento
Lake Berryessa	Lake Cachuma
Modesto Reservoir	Lake Hemet
Turlock Lake	Lake Henshaw
Los Banos Reservoir	Delta A - Sacramento River
San Luis Reservoir	Delta B - Yolo Basin/NW Delta
O'Neill Forebay	Delta C - North Delta
Eastman Lake/Buchanan	Delta D - West Delta
Hensley Lake/Hidden	Delta E - East Delta
Millerton Lake/Lost Lake	Delta F - South Delta
Lake Kaweah	

6.2.1 Gravity Travel Cost Recreation Demand Models

The model is specified as a variation of a gravity model because the California Department of Parks and Recreation (CDP&R) data set represents a household survey of recreator preferences rather than observed origin-destination travel patterns. Origin-destination observed data are not available. A recreation gravity model is called for when information about people's preferences for participation in activities can be matched to information about suitable destinations for their preferred activities. Such a model can distribute recreators from the household origins to the system of recreation destinations based on the relative attraction and cost of each site compared to others available to the recreator. The choice theoretic basis for the gravity model approach hinges on the individual's selection of that site that represents the lowest access cost and greatest attraction, given that a trip is taken. A recreation gravity model must fulfill two conditions to yield benefit measures. It must:

6. Distribute the recreators to destinations based on economic behavior; and
7. Derive the benefits arising from use of the sites directly linked to the same assumptions about recreator choice behavior that led to the original site choice.

In short, the model must distribute and value the recreators' user-days based on the same utility function. The model measures on a cardinal scale the abilities of site characteristics to provide specific recreation activities. Our specification relates visitation explicitly to access costs for specific activities and to the ability of sites to provide specific recreation services sought by the recreators.

6.2.1.1 History of the California Travel Cost (CTC) Model

The California Travel Cost model has been in use for 14 years. It was first developed in 1987 by William Wade and a group of economists working under contract to Metropolitan to estimate visitation to and recreation benefits for freshwater destinations within California. Wade presented testimony in the Bay Delta Hearings. “Economic Evaluation of the Recreation Resources of California's State Water Project and the Sacramento-San Joaquin Delta,” State Water Contractors Exhibits 64 and 66, June and September 1987. The model was relied upon within the 1988 American River water marketing EIS, “Estimating Instream Flow Recreation Benefits on the American and Sacramento Rivers.” Subsequently, the model was used to predict visitation and benefits for the Bureau and Corps of Engineers reservoirs within the state.

Under contract to the Department of Water Resources, the Bureau of Reclamation and Metropolitan Water District, the model was updated and used to predict visitation to the planned new reservoir south of the Delta, “Recreation Forecasts and Benefit Estimates for California Reservoirs: Recalibrating the California Travel Cost Travel,” 1991. DWR relied on the model in 1992 to predict visitation and benefits for expanding Littlerock Reservoir in Angeles National Forrest. The model was recalibrated in 1997 for use in predicting visitation to Metropolitan’s new reservoir in Riverside County, Diamond Valley Reservoir. It was used extensively between 1997 and 1999 in conjunction with plans for Metropolitan’s new reservoir.

6.2.2 Recreation Participation Database

Specification of the estimated model reflects the nature of the available recreation data in California; we developed no new survey information about recreation travel patterns within our analysis. Observed visitation in 1997 at each site is the dependent variable. The independent variables include site attributes and a recreation participation database developed by CIC research for CDP&R from surveys. These sampling results became the basis for the CIC database and the recreation participation model. The database contains information about recreators in California based on household surveys about recreational patterns and secondary data on socio-economic categories. User-day, activity-day and visitor-day are terms used in this article and in the literature.

- Visitor-day is defined to be a day at a recreation site by a single person doing any and all activities.
- Activity-day is defined as the activities participated in during a recreation day. Two or more activities equal two or more activity-days.

6.2.2.1 Freshwater Activity Participation Days

Activity-days are counted in the CIC data set. The estimated potential demand for the freshwater activities included within our data set for 1997 far exceeds the observed visitation to recreation facilities. The number is overstated for two reasons:

1. Activity rather than visitor days are reported; and
2. The survey is prone to “optimistic” recollection of outdoor activity respondents. CIC chose to discount survey responses using a technique that squares the reported participation rate (e.g., if 50% of respondents said they engaged in a recreation activity, CIC reported $.50^2 = .25$, or a 25% participation rate). The approach especially discounts activities with small participation rates. E.g., an activity with a .05 participation rate would be discounted to .0025. In the first case, the “adjusted” participation is discounted to ½ of the stated numbers; in the second it is discounted 1/20th. We choose to use the unadjusted numbers and let the CTC model adjust stated recreation demand down to actual arrivals at destination reservoirs.

Adjustments must be made to convert activity-days to known visitor arrivals at the sites, or visitor-days. Double counting of multiple activity-days is avoided both by data management and by the estimating method that scales the model results to actual visitor arrivals at the sites in the database. Camping was dropped as a separate primary activity because the data show that boating, fishing and freshwater lake swimming/picnicking all occur in California to a large extent with camping. About half of boating, fishing and swimming/picnicking activity-days include camping. Hence, three primary activities are tracked within our analysis. Camping is considered a cost-reducing element rather than a primary activity.

6.2.3 Treatment of Site Attributes in the Model

Characterizing site attributes is essential to travel cost modeling. Recreators choose a site based on the quality and quantity of the services the site provides. We developed a set of attributes specifically keyed to the ability of a site to provide recreation services. Our selected site attraction attributes are the facilities that augment the water body to support specific activities. The attributes measured are those facilities observed to be limiting factors in the supply of recreation services for an activity. Site attributes are measured on a cardinal scale. Measured on cross-section data, the surface acreage variable, SA, discriminates size of the destination. The following variables are defined:

- Number of boat launch lanes, houseboats, and marina slips for boating/water skiing/other boating;
- Annual natural fish production of the lake (as rated by CDF&G) plus cumulative fish stocking over two years;
- Parking spaces for swimming/picnicking;
- Number of campsites for camping. (Explicitly accounted for in the cost term.)

Based on these facilities and the other variables, the model allocates

1. Recreators from each origin seeking an activity to the sites that provide the best available services at the lowest access cost; and
2. Predicted visitation at each site to the mix of activities that makes best use of the facilities (attributes) of the site.

6.2.3.1 Delta-Specific Attributes

Most of the destination faculties in the CTC site database are natural lakes or reservoirs with well-defined recreation areas. Notably, most have a front gate from which visitation can be counted directly. Of course, these attributes do not apply to the Delta. Tabulating site characteristics for the Delta is more difficult than for stand-alone recreation areas due to the large number of privately operated marinas as well as public parks and access areas. We rely on a mix of survey data to determine Delta characteristics. Where possible, we use data from the 2000 inventory of Delta facilities undertaken by the Dangermond Group for this study. We use the Dangermond data for the following:

- Boat Launching and Marinas;
- Surface Area;
- Camping; and
- Fees for all activities.

Unfortunately, not all of the data required for the CTC model were sampled in the Dangermond survey. For these, we rely on survey data conducted in 1991 for a previous estimation of the CTC model:

- Fish stocking; and
- Day use parking.

Other characteristics of the Delta make it unique from most of the lakes estimated in the CTC model.

- The Delta has few opportunities for picnicking, swimming from shore, and other "park-like" activities. The lack of turf-oriented recreation activities should be well described by the parking space variable in the model.
- The average size of boats used on the Delta is larger than at recreational lakes. Because this implies more persons per boat, it increases the throughput capacity of the Delta. We adjusted the boating throughput capacity of the delta upwards by a factor of 20% based on the ratio of the average reported boat party size in the Delta (reported in the 1997 *Delta Recreation Survey*) to the average party size at recreation lakes.

6.2.4 Specification of Access Costs

The cost function is specified to measure costs per visitor-day. The model is specified in terms of actual visitor-days as the observed variable. Potential activity-days are adjusted to visitor-days within the model. The cost term is specified carefully to match the visitor-day concept. The cost equation is specified to reflect opportunity costs of individual recreation visitor days rather than individual trip costs because much of the visitation to the reservoirs includes camping and multiple-days on-site. Trip costs are an internal step to our specification. Our specification recognizes that multiple days on site incur fractional trip costs but additional overnight costs.

The availability of camping facilities is an important determinant of recreators' choice behavior. About one-half of freshwater activity recreators prefer to camp when they go boating, fishing, or swimming/picnicking. Recreators have the choice to trade camping nights for additional round-trips to reduce the cost of a visitor-day. Camping enters recreators' choice behavior as a cost reducing consideration. Thus, sites that offer a greater chance of getting a campsite have a lower access cost per visitor-day. As the number of campsites increase at a location relative to primary recreation activity attributes, a recreator would be more likely to be able to camp. A greater probability of camping causes the average cost of a visitor-day to decrease because travel costs per day of recreation are reduced.

The choice of site is directly influenced by the cost of a visitor-day at that site; thus more campsites decreases the average cost of a day and increases the economic attractiveness to the recreator. The cost term is affected by the number of days each recreator expects to stay at the site after traveling from home. Daily average trip expenses are determined by the average number of days per trip per recreator, amount of fees paid to participate in activity k at the site, travel time from the origin county to the site, the assumed opportunity cost of travel time, and vehicular costs. Elements of the cost function capture activity-specific costs.

The cost equation measures the average out-of-pocket expenses plus opportunity cost of travel time incurred by a visitor participating in each activity. The cost terms for each activity are identically specified except boaters are assumed to be able to camp in their boats within the Delta and certain reservoirs that allow overnight boat camping. As boat camping has no fee this makes the Delta a lower cost boating destination because it has so much boat camping capacity.

Vehicle operating costs are determined from published Department of Commerce sources and trip costs are calculated based on a distance matrix from the 58 population-weighted county centroids to the sites developed by CalTrans[6]. Trip expenses were divided by passengers and by average days on-site to convert to travel expenses per specific activity. Average county wage rates are determined from the household income characteristics generated by the California Department of Finance. User fees charged reflect the decision to recreate one day or overnight. They were determined by survey. No food expenses are imputed; nor is opportunity cost of time on site included.

The appropriate value for the opportunity cost of time has not been consistently determined within the economics literature. One-third to one-half the wage rate has been a standard assumption in the literature for the opportunity cost of travel time although one recent study shows that the value can exceed the wage rate, based on a sample of California salt water Anglers. Our travel cost model has been specified to allow sensitivity testing from one-third of the wage rate to the full wage rate because recent research confirms that the fraction is an empirical consideration rather than an assumption with a regular pattern among recreators. We do not have sufficient empirical information about the opportunity cost of freshwater recreation in California to set the fraction. The opportunity cost of travel time was set equal to one-third the average wage rate in the county of origin to be conservative.

6.2.5 Treatment of Substitutes

Economic theory requires substitutes to be an argument of demand functions. Each of the different 58 county origins faces a different access cost to the substitutes and a different value for the substitute term. A larger value for the substitute term for a given implies a larger set of low access cost good substitutes for activity. Recreators in the South with fewer nearby substitutes will face a smaller value for the substitute term than recreators in the North because the access cost of the faraway sites will be higher

6.3 Estimated Model Results, Forecast Visitation 1997 - 2020

6.3.1 Model Results

CTC model results are shown in Table 2.The signs and magnitudes of the coefficients are all reasonable. Most variables are highly significant. The r^2 indicates that the model explains a large percentage of recreation visitation. This, in conjunction with the large t-statistic on the transformed boat lanes and parking spaces, suggests that visitation to the Delta, lakes and reservoirs is explained well by the maximum daily throughput capacity of the facilities at the sites.

[6] The authors would like to thank Les Jones, Leonard Seitz, and Keith Farnsworth of the California Department of Transportation for developing the custom travel time matrix for this study

Table 2. CTC Model Coefficients

Variable	Description	Coefficient	T-Statistic
B0	Constant	0.04	6.74
B2	Travel Cost	-0.77	-3.33
B41	Boat Lanes	1.41	2.30
B42	Fish Yield	0.70	1.88
B43	Parking Spaces	0.77	5.25
B5	Surface acreage	0.88	11.26
r^2= .779			

The coefficients are estimated as exponents and are considered elasticities except for b0, which is a scalar that adjusts potential activity-days to actual visitor arrivals. Freshwater recreation is shown to be somewhat price inelastic by the size of b2, -0.77. The elasticity on surface acreage, b5, .88, is somewhat unexpectedly large. The nearly unitary elasticity suggests that visitation increases in a nearly linear relationship with reservoir size. The size of the t-statistic on surface acreage confirms that size of water' body is an important determinant of people's recreation choices. Given that many of the freshwater bodies near urban areas operate near capacity on summer weekends, size matters.

The model discriminates differences in the way that boaters, anglers and picnickers/swimmers respond to changes in the availability of the separate facilities to support boating, fishing and picnicking/swimming. The size of the b4l coefficient on boating indicates that the number of boat lanes are more important to the recreators than size alone of the reservoir or the number of parking places or productivity of the fishery. The elasticity of the boating attribute is shown to be over twice the size of the elasticity of the fishing or swimming/picnicking attribute. Boaters are quite responsive to the number of boat lanes. In view of observed boating congestion at a number of reservoirs, boaters clearly are sensitive to the probability of getting their boats on the water.

6.3.2 Forecast Visitation

The estimated parameters on Table 2 allow us to impute demand curves for each site in the data set and estimate total visitation. The predicted visitation for the Delta is shown on Table 3. These estimates are based on output from the CTC model, adjusted for the model's underestimation of seed data provided for the Delta[7].

Table 3 shows the estimates of Delta boating, fishing, and day use visitation -- 6.4 million visitor days for 1997, the year for which the baseline model is estimated. Visits to the Delta will rise to over 8 million visitor days by 2020, a 25 percent increase over the period. These estimates are somewhat lower than previous estimates of Delta visitation using the same modeling approach. There are a number of possible reasons for the lower visitation estimates.

[7] Though actual Delta visitation is unknown, the model must be provided with "seed" data for the Delta. Otherwise, the model would attempt to distribute recreation demand for the origin regions near the Delta to other nearby lakes and reservoirs. The model would "force" the millions of visits to other destinations.

Table 3. Estimated Visitation to Delta by Region: 1997 - 2020

Delta Region	1997	2000	2005	2010	2015	2020
A - Sacramento River	843,686	875,689	924,019	973,939	1,010,070	1,050,370
B - Yolo Basin/NW Delta	348,051	364,182	390,845	418,936	442,170	468,875
C - North Delta	960,772	1,000,260	1,058,829	1,115,796	1,152,973	1,193,749
D - West Delta	2,674,240	2,783,031	2,946,051	3,106,727	3,214,213	3,334,591
E - East Delta	858,018	890,445	940,713	994,902	1,036,449	1,084,240
F - South Delta	685,949	711,865	752,250	796,454	830,765	870,173
Total Delta	6,370,717	6,625,472	7,012,707	7,406,754	7,686,640	8,001,998

The foremost reason for lower visitation estimates is that the 1991 research was based on data from the mid-late 1980s, a period during which visitation to many California recreation areas peaked. Through the early to mid 1990s, visitation gradually declined from these peak levels, as shown in Figure 2. These trends at these reservoirs are assumed to apply to the Delta as well. Another explanation is, simply, that the data on Delta attributes have been updated with the exhaustive inventory undertaken for this project. Past uses of the CTC model appear to have used high estimates of Delta attributes, which may have pushed up visitation estimates.

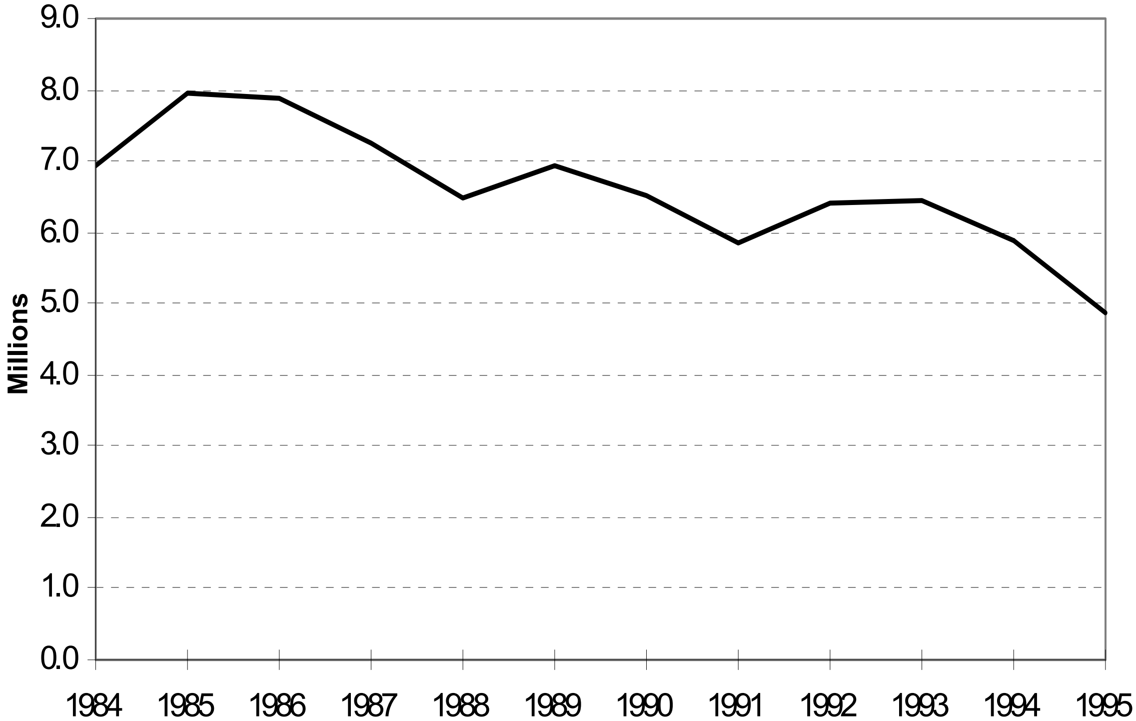

Figure 2. Attendance at Selected Major California Freshwater Recreation Destinations, 1984 – 1995.

Destinations include Perris, Silverwood, Skinner, Folsom, Oroville, Millerton, Salton Sea, San Luis, and Turlock.

Table 4 allocates the 1997 predicted visitation by activity across the regions of the Delta shown on Table 3. The percentage distribution and number of predicted visitors are shown. The predicted visitors are overwhelmingly boaters and anglers. Only in the South Delta do anglers outnumber boaters. Keep in mind that our approach aims to eliminate double-counting of visitors. Pointedly, we count anglers who boat as anglers. Hence, the reported anglers are doubtless on boats; but the primary purpose of their trip is to fish. Hence, the sum of boaters and anglers probably represents the total number of the people recreating in the Delta related to boating: approximately 5.71 million people in 1997.

Visitor days by activity are distributed in relation to facilities in the model. Hence, outyear recreators by region would maintain the same percentage distribution, unless facilities change. Hence, The outyear numerical forecasts are not shown on Table 4.

Table 4: Predicted Visitation by Activity, 1997

			Boat	Fish	Picnic	Sum
A - Sacramento River	Delta (357)	843,686	73.80%	19.91%	6.29%	100.00%
B - Yolo Basin/NW Delta	Delta (351,111)	348,051	64.95%	14.99%	20.06%	100.00%
C - North Delta	Delta (368)	960,772	83.27%	7.59%	9.14%	100.00%
D - West Delta	Delta (368)	2,674,240	83.27%	7.59%	9.14%	100.00%
E - East Delta	Delta (386)	858,018	58.80%	17.39%	23.81%	100.00%
F - South Delta	Delta (374)	685,949	48.28%	51.72%	0.00%	100.00%
Total Delta		6,370,716				
A - Sacramento River	Delta (357)	843,686	622,617	167,967	53,102	843,686
B - Yolo Basin/NW Delta	Delta (351,111)	348,051	226,058	52,166	69,827	348,051
C - North Delta	Delta (368)	960,772	800,015	72,904	87,854	960,773
D - West Delta	Delta (368)	2,674,240	2,226,786	202,923	244,535	2,674,244
E - East Delta	Delta (386)	858,018	504,555	149,169	204,295	858,019
F - South Delta	Delta (374)	685,949	331,167	354,783	0	685,950
Total Delta		6,370,716	4,711,197	999,911	659,613	6,370,721
Total Delta			73.95%	15.70%	10.35%	

6.4 Comparison to Other Studies

As a part of this study, an examination of recent literature on Delta visitation was undertaken. A summary of relevant research is presented in Appendix B “Summary of Recent Delta Research.” Only two studies in recent years have explicitly attempted to estimate visitation in the Delta. The first was a previous incarnation of the present work using the CTC model in 1991. Not surprisingly, the current results tie closely with the 1991 results. The other recent study to estimate visitation to the Delta was the 1997 CDP&R study *Sacramento-San Joaquin Delta Recreation Survey* (Delta Recreation Survey). Unfortunately, the results from the Delta Recreation Survey are not comparable to those from the current study because it counts activity days rather than visitor days. The boating survey yields 35.2 million activity days for boating-related activities. No attempt is made to determine how many visitor days this number converts to. The current research is the only effort in almost ten years to estimate visitor days to the Delta. While it is unfortunate that the results of the current study cannot be compared with those from other studies or, better yet, empirical evidence of Delta visitation, the results are plausible and are based on a proven analytic tool.

APPENDIX B

SUMMARY OF RECENT DELTA VISITATION RESEARCH

Sacramento-San Joaquin Delta Recreation Survey

The Economic Impact of Recreational Boating and Fishing in the Delta

Recreational Boating Trends in California

The Economic Impact of Boating in California

Sacramento-San Joaquin Delta Recreation Survey

Study Sponsors: CDP&R, Delta Protection Commission, 1997.

The Delta Recreation Survey provides the most thorough and recent study of Delta recreation. Two separate surveys were undertaken, one of registered boaters and the other of fishing license-holders. The study offers much useful information relevant to the current research. Its fatal shortcoming is that visitation estimates are based on activity days, from which visitor days are impossible to determine. This failing is found on most recreation surveys, including the CDP&R statewide recreation survey used as the foundation of the CTC modeling. A question on the survey form asking respondents which of the activities they engaged in was their primary, or destination, activity would allow an actual count of visitors.

The activity days problem notwithstanding, the Delta Recreation Survey offers a wealth of information that can be tangentially applied to the current research, including the following:

- Descriptions of the Delta regions' attributes can be used to hone CTC model variables;
- The relative differences between reported visitation in each region can be compared with CTC model results;
- The monthly and day-of-week visitation data can be used to convert annual CTC forecasts to monthly and daily estimates;
- Survey responses regarding adequacy of facilities can be directly compared with results of the current research's survey;
- County of origin data from the Recreation Survey can be applied to CTC model visitation forecasts;
- Estimates for other activities such as wildlife viewing and sightseeing, which are not included in CTC model estimates, can be estimated—at least on an activity day basis; and
- Per person spending estimates from the Recreation Survey can be combined with CTC visitation forecasts to arrive at annual spending in the Delta.

Comparability to Current Study Objectives and Approach

The greatest shortcoming of the Delta Recreation Survey is its failure to estimate visitor days. Thus the primary results of the survey are not compatible with the aim of the current research. Even the gross estimates of boating and fishing could be skewed upward for the following reasons:

- The authors assume that all of the respondent's reported recreation occurred in the Delta[8]; and
- The authors assume that responses are for a single individual only, whereas the question asks about "you or someone in your group." A respondent who went boating with the same 4 people 25 times a year might report 25 trips or 100 trips. If the person reports 100 trips, the

[8] The survey question asks "How many days did you or someone in your group participate in each activity in 1996?"

survey methodology would apply those trips to each individual, resulting in a gross overestimation of total trips.

The Economic Impact of Recreational Boating and Fishing in the Delta

Study Sponsors: U.C. Berkeley Dept. of Agricultural and Resource Economics

This study uses the results from the 1997 Delta Recreation Survey to estimate the economic effects of boating and fishing. The authors cite the problem of not being able to sum boating and fishing activity days, and do not make the mistake summing over all of the boating activities. The study then multiplies activity days times per capita spending to arrive at an estimate of gross recreator spending in the Delta. This spending is then run through a standard input-output economic model to calculate the resulting gross output, personal income, and employment. These amounts are compared with overall Delta economic activity, for which a baseline is provided.

Comparability to Current Study Objectives and Approach

The largest problems with this study are the visitation data upon which it is based, which are irreparably flawed due to design of the original survey. As the visitor numbers upon which this analysis is based are flawed, the resulting economic analysis is misleading, no matter how methodologically well done.

The CARB boating study described below captured boating expenditures data, but only statewide. Their statewide estimates are compared to the Berkeley Delta estimates in Table 1. Keep in mind that statewide estimates include coastal boating expenditures. Therefore, the sum of the Berkeley study's boating and fishing expenditures, which would total 36 percent of CARB's statewide estimate, is disproportionately high compared with the magnitude of activity that occurs along the coast and elsewhere. The Delta expenditures estimate may not be bad estimates if you assume boating subsumes Delta fishing, and that the fishing sample might have been slightly skewed on lodging. This comparison suggests that perhaps 15 percent of California boating expenditures occur within the Delta. Ultimately, however, the visitation data are so flawed that the expenditures remain only a guess.

The economic analysis could be disassociated from the Berkeley visitation estimates and run on an improved set of visitation forecasts from the CTC model to arrive at an estimate of recreation's impact on the economy of the Delta region.

Recreational Boating Trends in California

Study Sponsor: California Air Resources Board (CARB), 1997.

CARB commissioned this study to better estimate the air quality impacts of future powerboat usage, as boat engines can be significant air polluters. Recognizing that boats are often used far away from the registration address, the study surveyed 1,048 registered boat owners in the state about how often they use their boats and where. The results were then tabulated to estimate the number of boating trips a boat owner in each county made to each of the state's 58 counties. No distinction is made for the type of boat used or the type of boating activity. Forecast units are boat activity days. As previously discussed, activity days and visitor days are not necessarily equivalent. However, since the boating aspect of a boating-related recreation trip is typically considered the primary recreation activity, the trips reported here can be viewed as roughly equivalent to participation days.

Comparability to Current Study Objectives and Approach

The most interesting aspect of this study is that boaters were directly asked in what counties these chose to recreate. This allows a direct tabulation of the origin of each county's boating activity. The CTC model cannot provide this tabulation; rather, the travel time and associated cost for each destination is included among other variables to estimate where boater choose to go. Many factors reduce this study's applicability to the current project:

- Trips to the Delta *per se* are not estimated;
- No distinction is made between various boat types and recreation activities;
- Participation is counted in units of boat trips, rather than person trips. It would be easy to convert to person trips by multiplying times the number of persons per boat. However, the number of recreators per boat varies with the boating activity, for which no detail is provided.
- Boating forecasts are functions only of county population and personal income, whereas our research indicates other demographic variables are significant;
- Decreased boating due to congestion is estimated based on survey responses, not observed visitation patterns. People's *a priori* beliefs about how they will respond to new circumstances and how they actually respond when confronted with them can vary greatly.

The Economic Impact of Boating in California

Study Sponsor: CA Dept of Boating and Waterways (DBAW)

While the final product of this study is similar in nature to that of "The Economic Impact of Recreational Boating and Fishing in the Delta," albeit on a statewide level, it arrives at its estimates in an entirely different fashion. Whereas the Delta study starts with the numbers of boaters and "builds up" to their economic impact, this study dissects Standard Industrial Classification (SIC) based estimates of boating-related economic activity from state and federal statistics, among other sources. The SIC classification system, maintained by the Office of Management and Budget, enumerates a code for virtually every industry. These codes are used when reporting economic data to state and federal agencies. The authors culled all of the boating-related SICs and the associated level of statewide economic activity reported for each.

Comparability to Current Study Objectives and Approach

The highly aggregated (statewide) nature of the data lends little use to Delta-specific estimation.