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VALUING MARINE RECREATIONAL FISHING ON THE PACIFIC COAST

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Energy and Resource Consultants, Inc.

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Robert D. Rowe
February, 1985

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1.0 INTRODUCTION AND SUMMARY CONCLUSIONS

This study presents estimates of the value of marine recreational fishing along the Pacific coast of the continental USA. These estimates include values for a typical fishing day and aggregate values for different types of fishing and at different geographic locations. Economic estimates of damage are also provided for changes in the availability of fishing modes and areas. For example, a damage estimate is provided for the loss of shore fishing at individual counties along the pacific coast.

While over 13.5 million marine recreational fishing days occurred along the pacific coast of the continental USA in 1981, little is known about the value of the marine recreation fishing experience and, therefore, of the marine recreational fishery. A few authors have examined economic values for pacific coast marine recreational fishing at selected sites, or values held by those fishermen with selected target species (Brown et al., 1977, 1983; Huppert and Thomson, 1984; Crutchfield and Schelle, 1978; SMS Research, 1983; McConnell and Strand, 1981), but none have attemped to examine per day and aggregate values for the recreational use of the entire fishery. This research takes an important first step to fill that void.

1.1 OBJECTIVES

The primary objectives of this research were:

1. To estimate the Gross and Net economic value of marine recreational fishing along the pacific coast of the continental USA. Gross is defined as the total willingness to pay (WTP) by fishermen including actual expenditures, travel costs and uncaptured values related to participating in marine recreational fishing. Net is defined as the total WTP minus actual expenditures, or what economists call the consumer's surplus (or uncaptured values).

2. To estimate gross and net economic values for a typical trip and in aggregate across all trips by mode of participation (beach and bank, man-made structures, partyboats, and private and rental boats), and by region (Southern California, Northern California, Oregon and Washington).

3. To examine the economic values associated with changes in expected fish catch, especially Salmon.

4. To examine the effect of socioeconomic characteristics of fishermen and site characteristics on the demand for and valuation of marine recreational fishing.

5. To use the best available economic methods to meet objectives 1-4 while also using existing survey data.

6. To evaluate existing marine recreational fishing survey instruments and redesign and pretest survey instruments to better aid in the implementation of economic models to estimate economic values of marine recreational fishing, specifically in the San Francisco Bay and Ocean area.

Other important objectives of the analysis were to:

7. Examine whether economic measures of value for pacific coast marine recreational fishing significantly change from year to year.

8. Consider the availability of substitutes when valuing changes in the availability or characteristics of a site or fishing mode.

9. Highlight how different economic methods provide estimates of consumer's surplus which differ in concept, and therefore quite naturally differ in magnitude.

10. Examine the effectiveness of alternative types of contingent valuation questions for valuing changes in expected fish catch.

The research reported herein provides data useful for a diverse array of policy related questions. For example, the results can be used to:

1. Assess the aggregate economic importance of marine recreational fishing along the pacific coast.

2. Assess the relative importance of commercial and recreational uses of the marine fishery, especially for selected species, when combined with other market data on commercial values.

3. Assess the economic loss to marine recreational fishing of environmental hazards that may result in temporarily elimination of recreational fishing either at a site, by a fishing mode, or for a particular species.

1.2 DATA

The economic analysis relies upon available data sets for pacific coast marine recreational fishing. The exact characteristics of the data sets are critical to the selection and implementation of methods to conduct economic analyses. The primary data sets, which are reviewed in more detail in Chapter 3.0, include:

- o <u>The 1981 MRFSS Intercept Survey.</u> Conducted with on-site marine recreational fishing participants in four fishery modes (beach and bank, man-made, partyboats, private and rental boats) along the entire pacific coast of the continental U.S.

- o <u>The 1981 MRFSS Telephone Survey.</u> Conducted through a random survey of households in counties on or within 25 miles of the pacific coast of the continental U.S.

- o <u>The 1981 MRFSS S/E Survey.</u> An intercept and mail follow-up survey of selected MRFSS intercept respondents providing additional perceptions and socioeconomic data.

In this analysis, the MRFSS telephone survey is used to estimate participation rates and total trips from each origin zone. The MRFSS intercept survey is used to determine the distribution of trips from each origin to different destinations and used to estimate economic measures of value and how individuals will substitute across sites as the characteristics of the sites change. The MRFSS S/E survey is primarily used to estimate average expenditures by fishing mode and location.

Both the MRFSS intercept and MRFSS S/E surveys have very detailed disaggregation of sites and species caught; each pier and beach are considered different sites, and several hundred species were considered. To facilitate the statistical and economic analysis to be conducted herein, sites were grouped into 37 "macro sites" (17 in California, 7 in Oregon and 13 in Washington) and species were grouped into 13 "species groups." Generally, the macro sites correspond to coastal counties along the pacific coast, as depicted in Figures 4.2-4.4. The 13 species groups are defined in Table 1.1.

1.3 METHODS

The economic estimates provided herein rely upon the use of variations of the travel cost method for valuing recreation sites. The basic travel cost approach recognizes that to use the services of a recreation site, users not only incur expenses of entry fees and equipment, but must get to the site. The cost, or price, to an individual of using the services at the site will vary according to the travel time and expenses inccurred getting to the site. The further away users are from a site, the greater the implicit price of using the site. The demand for visits to a particular site will also vary with characteristics of the site, especially expected fish catch, and with characteristics of the individual.

Table 1.1

List of 12 Species Groups

Species Group #	Species Included
1	Coastal Pelagics - Bonito, Pacific/Green & Jack Mackerel, Barracuda
2	Albacore
3	Tuna - Skipjack, Bluefin, Yellowfin, Bigeye Tuna, Yellowtail Other Tuna-like Species
4	Salmon, Trout
5	Swordfish & Billfish
6	Perches
7	Smelt & Grunion
8	Flatfish - Halibut, Sanddab, and Other Flatfish
9	Bass - Giant Sea Bass, Calico/Kelp Bass, Barred Sand Bass Spotted Sand Bass, Striped Bass
10	Rockfish and Bottomfish - Cow Cod, Red Rockfish, Other Rockfish, Lingcod, White Sea Bass, Other Croaker, Sculpin, Sablefish, Other Bottom Species
11	Sturgeon
12	Other Surface Species, Sharks, Skates, Rays & Eels
13	Fish caught but were unidentified

The primary economic valuation method used is a multinomial logit travel cost model. This model estimates the probabilities that an individual will fish at alternative sites given alternative sets of prices and site characteristics using a logit econometric technique. Based upon the model, exact estimates of consumer's surplus can be made for changes in characteristics at one or more sites. This variation on the travel cost method was selected because, relative to other travel cost models, it:

1. has strong theoretical foundations,

2. considers the substitution possibilities amongst the sites and fishing modes,

3. includes as independent variables the costs of visiting all the site/modes and the characteristics of all the sites and modes, including expected fish catch.

4. can consider characteristics of the individual,

5. can use either individual or aggregated data,

6. leads to the estimation of exact consumer surplus measures of economic value, and

7. can be estimated with the available data sets, accounting for their strengths and weaknesses.

An alternative travel cost model is estimated for comparison purposes. This approach uses a simple single-equation travel cost model with data on a number of trips taken by individual fishermen.

1.4 ANALYSIS PLAN AND REPORT ORGANIZATION

The analysis plan follows an 8 step procedure, which roughly parallels the organization of the report.

Step 1: Review of the economic literature on methods and applications for valuing marine recreational fishing (Chapter 2). This was undertaken to identify the alternative methods that may be undertaken and the issues that must be considered in their application so as to lead to the selection of specific methods to be applied.

Step 2: Review the available data (Chapter 3). This was undertaken to determine the relative ability to use alternative economic valuation approaches given the available data and to assess how new survey instruments might be redesigned.

Step 3: Selection and detailed design of the actual travel cost procedures to be applied to the available data sets (Chapter 4).

Step 4: Process and analyze the basic data to provide inputs to the economic models (Section 4.4). This included calculating participation rates from the telephone surveys, origin destination shares from the MRFSS intercept and phone surveys, catch rates by mode and site from the MRFSS intercept surveys, determining average expenditure data for different trip types and locations of trips from the MRFSS S/E survey and processing related data from the U.S. census and state governments.

Step 5: Using estimated multinomial logit models for each state, calculations of expected per trip net economic values are made for each state and fishing mode combination (Section 5.1.2). Changes in expected per trip values are calculated for several scenarios regarding changes in the quality or availability of marine recreational fishing along the pacific coast (Section 5.1.2 and 5.1.3). These scenarios include the elimination of all fishing in any one county, the elimination of offshore fishing in any one county, the elimination of shore fishing in any one county and changes in the expected catch of selected species at selected locations.

Step 6: Calculate aggregate net and gross WTP economic values for marine recreational fishing under existing 1981 conditions. In these calculation the aggregate number of marine recreational fishing trips is assumed to remain constant for the elimination of fishing sites along the pacific coast. This leads to an understatement of benefits of environmental improvement and an overstatement of the damages of environmental degradation.

Step 7: Preliminary comparison of methods and results across years (Section 5.1.5). The results of the Southern California multinomial logit models for 1981 and 1980 are compared. The results of the single equation approach using individual data, and the multinomial logit approach using aggregated observations where each county of origin is taken as an individual -- are compared for Southern California in 1981. All results are reported in 1981 dollars.

Step 8: Design and pretest a travel cost and contingent survey instrument in the San Francisco Bay and Ocean Area (Chapter 6). This instrument is to provide data to estimate conceptually correct economic measures of value for marine recreation fishing using any one of several available models. It is to also focus upon estimating values for changes in expected catch of Salmon and Striped Bass.

1.5 SUMMARY OF FINDINGS

Number of Trips

The number of marine recreational fishing trips to the pacific coast of the California, Washington and Oregon in 1981 is estimated to be 13.3 million, with nearly 77 percent of all trips to destinations in California (Table 1.2). Two thirds of the California trips were to destinations in Southern California (Table 4.5). The aggregate pacific coast estimate of trips is down 10 percent from the 1980 estimates of 16.6 million trips. It is estimated that trips to Southern California decreased by 25 percent while the number of trips to Northern California and Oregon showed small changes, and the number of trips to Washington increased by 75 percent. These changes in estimated trips may be accounted for by the facts that average fish catch in Southern California decreased dramatically from 1980 to 1981, while average Salmon catch in Washington increased by 7 to 12 percent (see Section 4.4.4).

Per Trip Expected Net WTP

Per trip expected net and gross WTP vary depending upon the origin of the participant and the change in the resource posited. The multinomial logit travel cost model estimated in this report calculates the probability that an individual will take a trip to each alternative site/mode combination available under alternative resource prices and conditions. The model therefore estimates expected changes in net and gross WTP based upon changes in the probabilities of visiting each available alternative, and the associated costs, under alternative resource conditions. Per trip expected net WTP (consumer's surplus) depends upon the county from which a trip is taken and the fishing site and mode (see Tables 5.2-5.4). The values reported in this and subsequent report sections apply to all trips from each origin county. The per trip expected net WTP values range from:

- $0.00 to $9.00 per trip for the elimination of shore fishing at any one individual county along the pacific coast.

- $0.00 to $7.00 per trip for the elimination of boat fishing at any one individual county along the pacific coast.

- $0.00 to $23 per trip for the elimination of all fishing at any individual county along the pacific coast.

These figures are generally smaller than those reported in other studies for valuing marine recreational fishing because other efforts have generally not addressed the eliminations of fishing for only one or all modes at one site while also considering site/mode substitutions.

Average and Aggregate Net and Gross WTP's

The expected net and gross loss from the elimination of each mode, and all modes at once, at all sites in each of the three pacific coast states has been calculated and are reported in Table 1.3 and 1.4. In total across all three states the aggregate net WTP is estimated to exceed $1,246 million in 1981

Table 1.2

Summary of the Number of Pacific Coast
Marine Recreational Fishing Trips in 1981*

	TRIPS ORIGINATING FROM				
	California	Oregon	Washington	Other States	Total
Trips with Destination to:					
California	9,758,500	9,900	7,300	406,600	10,187,300
Oregon	70,700	951,900	40,400	57,500	1,120,500
Washington	34,800	90,100	1,673,700	166,700	1,965,300
TOTAL	9,864,000	1,051,900	1,721,400	630,800	13,268,100

* Energy and Resource Consultants, Inc. Calculations based upon 1981 MRFSS Telephone and Intercept Surveys. See Section 4.4.

Table 1.3

Average Expected Net and Gross WTP per Trip by Mode in 1981 ($1981)

	Mode				
Site	Beach and Bank[1]	Man-made[1]	Partyboat[1]	Private Boat[1]	All Modes[2]
California					
- Net	$31.0	$25.4	$11.8	$23.1	$67.8
- Gross	63.0	53.0	89.7	61.8	97.6
Oregon					
- Net	$29.2	$ 35.5	$ 3.71	$10.1	$53.0
- Gross	91.5	109.7	25.0	45.3	95.8
Washington					
- Net	$ 53.0	$26.9	$ 6.02	$20.52	$45.9
- Gross	109.75	57.0	30.46	55.94	74.0

Calculated as the total net (reported in Table 5.5) and total gross (reported in Table 5.6) devided by total trips by mode (calculated from Tables 4.3 and 4.4).

1 Calculated for the elimination of the mode at all sites in the state.

2 Calculated for the elimination of all site/mode alternatives with a one percent or greater probability of being visited and calculated separately for each county of origin.

Table 1.4

The Aggregate Net and Gross Value of Pacific Coast Marine Recreational Fishing in 1981 by Mode and in Total*

($1,000 1981)

SITE	TRIPS ORIGINATING IN THE SAME STATE AS SITE					ALL TRIPS
	Beach and Bank	Man-made	Partyboat	Private Boat	All Modes	All Modes **
California						
- Net	$ 72,664	$ 56,986	$ 25,373	$69,708	$ 661,542	$ 690,253
- Gross	147,522	118,881	193,441	186,317	952,561	993,900
Oregon						
- Net	6,113	6,459	788	3,503	50,421	59,351
- Gross	19,172	19,937	5,308	15,773	91,182	107,332
Washington						
- Net	10,822	8,502	3,095	13,120	76,797	90,177
- Gross	22,410	18,045	15,652	35,763	123,924	145,515
TOTAL						
- Net	$ 89,598	$ 71,947	$ 29,256	$ 86,330	$ 788,760	$ 839,781
- Gross	$189,105	$156,863	$214,401	$237,854	$1,167,667	$1,246,747

* Individual mode values are derived for the elimination of the mode at all sites in the state. All mode values are derived for the elimination of all modes/site combinations with a probability of being visited greater than or equal to one percent, defined separately for each county of origin.

** All trips all modes values (last column) calculated from in-state values for all modes and multiplied by the ratio of total trips to destination state divided by in-state trips (Table 4.4). See text for additional discussion.

(in 1981 dollars). The expected net and gross loss from the elimination of all fishing opportunities in each state are proxied by the elimination of all site mode alternatives for which the individual has a one percent or greater probability of visiting.

The aggregate estimates for the elimination of one or all modes may overstate aggregate net economic losses because the multinomial logit model used assumes the existing level of trips will continue to be taken, whereas some individuals will experience smaller consumer's surplus losses by substituting out of fishing rather than substituting to a new site/mode alternative. Similiarly the model will understate net economic gains from the addition of new site/mode alternatives, as new individuals may choose to participate or existing participants may choose to take more trips. Future work should represent these change in participation rate effects by linking multi-site participation models to the multinomial logit model. The choice and adaquacy of the approach to measuring aggregate total economic values in the multinomial logit model by the elimination of all sites with a one percent or greater probability of being visited is discussed in Section 5.1.2.

<u>Expected Net WTP for Changes in Fish Availability</u>

Expected net WTP (consumer's surplus) per trip was estimated for the elimination of all salmon fishing in each state. The expected per trip consumer's surplus losses range up to $2.90 in California, up to $5.90 in Oregon, and up to $7.27 in Washington, depending upon the county of origin of the trip. (See Tables 5.10-5.12). These are expected values that apply to all trips prior to their being taken.

Expected net WTP per trip was estimated for the increase in expected catch of a selected species for participants from selected counties. These values, reported in Tables 5.7 through 5.9 are summarized in Table 1.5. Again, these are expected values that apply to all trips prior to their being taken. Values for some species were consistently estimated to be negative. This may be the result of multicollinearity in the analysis and the fact that where these fish are caught, other more prized fish tend not to be caught.

Table 1.5

Per Trip Expected Net WTP Associated with
Increasing Selected Species Catch Rate by One
Fish Per Trip at All Site/Mode Alternatives Where the Fish is Caught: 1981

		SPECIES				
Selected Counties in State of	Salmon	Coastal Pelagics	Smelt	Rockfish/ Bottomfish	Flatfish	Perch
California	$0.00 to $9.99	$0.00 to $2.20	$ .42 to $ .94	-$1.41 to $1.45	NEG	NEG
Oregon	$10.27 to $13.97	NI	$ .15 to $3.16	$2.81 to $3.36	$1.69 to $7.09	NEG
Washington	$10.77 to $15.46	NI	NI	$1.61 to $2.24	NEG	NEG

1981 dollars. Summarized from Tables 5.7-5.9 . Values apply to all trips whether targeting this species or not.

NEG = Negative values estimated for trips from all counties of origin.

NI = Not included in the analysis as species is not frequently targeted at this site.

The consumer's surplus estimates for Salmon fishing must be given a caveat. There is an unknown amount of bias likely leading to an understatement of values. This is because the MRFSS surveys used in the analysis are based upon a methodology that tended to substantially reduce sampling of Salmon and Striped Bass fishermen, thus under representing the percentage of trips taken for this purpose.

Comparison Across Time

The multinomial logit model was estimated for Southern California in 1980 and 1981. The net and gross expected per trip values are quite similar for shore modes, somewhat higher in 1981 for partyboat trips and somewhat lower for private boat trips (see Tables 5.14 and 5.15). On average across all modes and sites, the estimates are within a few percentages points, implying consistency across years in terms of the travel cost model estimates. As a result, aggregate values for all trips can be expected to be higher in 1980 in proportion to the number of trips taken. The difference in expected net and gross WTP per trip may be attributable to differences in expected fish catch.

Development of a New Survey Instrument for the San Francisco Bay and Ocean Area (SFBOA)

The implementation of a new survey instrument could greatly enhance the ability to undertake economic analyses of marine recreational fishing in the SFBOA. The pretest showed that a procedure of following up with MRFSS telephone respondents will be cost effective and have high response rates. The pretest results indicate values for Salmon fishing of a similar order of magnitude as found with the multinomial logit travel cost model analysis. The pretest also suggests that the value of travel time may be related to numerous socioeconomic and trip characteristics, rather than just income.

1.6 CONCLUSIONS AND RECOMMENDATIONS

Conclusions

These findings suggest there are substantial values related to marine recreational fishing on the pacific coast, especially for the protection from elimination of all site/mode combinations. However, the net WTP values for the protection of individual sites, fishing modes or species are much smaller than would be estimated with many versions of a travel cost model. This stresses the importance of using techniques that account for substitution across fishing alternatives.

Recommendations

The principal recommendations for extentions of this work include:

- The estimation and linking of a multi-site participation model to the multinomial logit model to better account for substitutions between fishing and non-fishing activities.

- The use of the model to develop aggregate economic welfare estimates for changes in the stock of selected species.

- Full survey execution of the San Franciso Bay and Ocean Area instrument and analysis of the results.

- The use of the model to predict market shares for new fishing site development, especially for the operation of partyboats at new locations.

2.0 ECONOMIC CONCEPTS AND METHODS USED TO VALUE MARINE RECREATIONAL FISHING

2.1 INTRODUCTION

This chapter broadly reviews the concepts, methods and issues related to valuing marine recreational fishing using travel-cost methods. Results of related efforts are also summarized. This review describes the types of available methods and theoretical and application issues related to their use. It is presented to broadly identify methods that may be of use in this analysis and implementation issues, but is not intended to be a detailed review of the literature. A recent thorough review of travel-cost models and issues may be found in Bockstael et al. (1985).

2.2 CONCEPTS AND MODELS

2.2.1 Concepts

The theoretical constructs used to value changes in recreation resources, such as marine fishing, have been well laid out in the welfare economics and recreation literature, especially for activity or user values -- those recreation values gained through undertaking the experience. Several such reviews are found in Freeman (1979), Rowe and Chestnut (1982), Dwyer et al. (1977), Research Triangle Institute (1982), WRC (1979), among others. The basic concept is to estimate total expenditures plus the appropriate measure of consumer's surplus (compensating variation, equivalent variation etc.) from engaging in an activity or for changes in characteristics of the activity or resource. The consumer's surplus measure is a monetary measure of the change in utility from the change in the recreation resource, and is equal to the change in income that results in the same change in well-being (or utility) as the change in the resource or experience being valued. For example, if one's favorite fishing spot is no longer available and trips are taken to a new site, expenditures might not change, but one's well-being might be diminished.

In this example, consumer's surplus is a monetary measure of this unpriced value associated with the loss of the availability of one's favorite site.

Total expenditures plus consumer's surplus is referred to as "Gross Willingness-to-Pay" (WTP) for the recreation experience and consumer's surplus alone is sometimes referred to as "Net WTP." Each is an "economic welfare measure" related to the use of the resource.

Travel-cost models, and other benefit estimation approaches, provide methods for both explaining recreation behavior and, with the application of data, the estimation of the desired economic welfare measures.

2.2.2 Travel-Cost Methods

Clawson-Knetsch Type Methods

The travel-cost method has been used extensively to estimate the demand for benefits of recreation activities, particularly at specific recreation sites. Suggested by Hotelling (1949), initially developed and applied by Clawson (1959) and Clawson and Knetsch (1966), and refined by a great many authors, this approach recognizes that to use the services of a recreation site, users not only incur expenses of entry fees and equipment, but also the expenses associated with traveling to the site. The cost, or price, to an individual of using the services at a recreation site will vary according to the travel time and expenses inccurred getting to the site. The further away users are from a site, the greater the implicit price of using the site.

The simplest Clawson-Knetsch (C-K) travel-cost approach may be implemented by assuming there is only one site to be considered by recreationists and by assuming the supply of services (recreation visits) at the site is infinite at the travel-cost price (travel-cost plus entrance fees and other user costs) for each individual. Next, by establishing visitor use rates for recreationists from different distances from the site, a regression analysis of the visitation rates as a function of the travel-cost measure of price and socio-economic characteristics of the recreationists from different distances is used to estimate a demand curve for the site services. This is frequently done at an aggregate level using visitations at a site for recreationists from different origins. It may also be performed with micro-level (household) data on recreation behavior when such data exists, as is the case with the MRFSS surveys.

In many typical applications of the C-K travel-cost approach, a demand curve is estimated relating the travel-cost price to the actual number of visits for a particular site at a single point in time. Because environmental or resource quality, such as fishery stocks, does not change at any point in time, these variables are often not included in the simple C-K models. Next, the benefits of having, versus not having, the resource at a site, given current conditions, are calculated as equal to the consumer's surplus derived by recreationists, i.e., the difference between the demand (WTP) curve and the entry fee and other travel-costs.

Many simple C-K travel cost models do not explicitly consider the availability of substitute sites so that if a site's resources are changed or eliminated and fishing trips to the site are predicted to decrease, it is not known whether these trips are taken to a substitute site for the same activity, or to another activity all together. Further, by not considering changes in the levels of the fishery resource across several sites and fishing modes, rather than just with the existence of the resource at one site, the simplified C-K approach will not yield the desired information for our analyses.

A generalized presentation of the travel-cost demand estimation for the ith individual (or for all individuals for the ith origin) for each jth site/mode alternative, which includes resource quality and quantity variables and price at the study site and substitute sites and may be used to address the benefits from changes in fishery resources, is:

$$Vij = Vij\ (Pej,\ Px,\ Dij,\ C,\ Tij,\ Di,\ Sih,\ Ei,\ RQ,\ Mi,\ Zi,\ eij) \quad (2.1)$$

where:

- Vij = number of visits by individual i (or by individuals from i) to site/mode alternative j.
- Vij(*) = visitation functional form which may vary across all j site/mode alternatives and all i individuals.
- Pej = vector of money prices of entry (possibly 0 in some cases) to the various modes (at various sites).
- Px = vector of prices of private goods.
- Dij = vector of round-trip distances from residence of individual i to the various sites/mode alternatives j.
- C = unit cost of travel miles.
- Tij = vector of travel times to the various site/mode alternative j for individual i.
- Di = cost of travel time.
- Sij = on-site time for i at site/mode j.
- Ei = on-site value of time.
- RQ = vector of resource and environmental quality and quantity measures of the various modes at various site/mode alternatives (such as fishery stocks or catch rates, scenic beauty, etc.).
- Mi = money income of individual i.
- Zi = vector of other socioeconomic and attitudinal variables.
- eij = random error for individual i at site/mode alternative j.

Demand for recreation activities for each mode/site alternative is a function of the travel-costs and entry fees, the money cost of time in travel and recreation, socioeconomic variables, all prices, and resource environmental quality and quantity variables for all modes at all sites. Economic theory will often constrain the ways these variables enter the Vij(*) function. Distance and unit travel-costs are included to represent the out-of-pocket costs, while travel time and site time are included to represent the opportunity cost of getting to and staying at a site. Resource and environmental variables for all alternatives are included because if these conditions are known in advance by the recreationists, it is likely that they will influence the choice of modes, sites and rate of activity.

The demand for trips to one or more alternatives (perhaps one mode at several sites) can be estimated in one large equation (Cesario and Knetsch, 1976), as depicted in Equation (2.1). The Vij can also be estimated as a set of equations, one for each mode/site alternative, using seemingly unrelated regression estimation techniques (Burt and Brewer, 1971; Menz and Mullen, 1982; and Samples and Bishop, 1983) a comparison of these two approaches may be found in Caulkins et al. (1982). The coefficients on Pej, for $j \neq$ the alternative of the equation in a multi-equation approach represent the cross price effects that induce substitution across alternatives.

If a demand curve can be estimated for visits to an alternative as a function of price, given current mode and site characteristics, then for a given price consumer surplus can be determined in the usual way as the difference between demand (WTP) and expenditures.

While Equation 2.1 is conceptually straight forward, there are both theoretical and econometric issues and limitations associated with its application (beyond those such as the value of travel time that must be addressed by any travel-cost method, see Section 2.2.3). Estimating trip behavior to different sites in one equation (rather than in a multi-equation model with a separate equation for each site) requires one of two simplifications. The model may be estimated with only prices and characteristics of the visited site included in the same functional relationship estimated across all sites:

$$Vij = Vij\ (pij,\ RQj,\ JZi,\ Eij);\quad \forall i,j \qquad (2.2)$$

where:

Pij = the entry price and travel-cost to visit site i from origin i.

In this specification the functional relationship between Pij and RQj upon Vij is the same for all sites. Alternatively, prices to visit all sites and resource quality at all sites may be included in the relationship:

$$Vij = Vij\ (Pi1,\ Pi2...PiJ,\ RQ1,\ RQ2...RQJ,\ Zi,\ eij) \qquad (2.3)$$

but requires that changes in price from any origin to visit any site, Pi2 for example, has the same relationship to visits at all sites. The resource variables for all sites must also enter the function such that $\partial Vij / \partial RQj$ is a function of origin specific variables, such as Pij, otherwise the term of the function incorporating RQj will be the same for all observations and statistical estimation of the model cannot be undertaken. Further, the model estimates will likely be unstable due to high multicollinearity among the price variables. Generally, cross price effects cannot be construed to be equal unless the coefficients on all price variables are the same. These models (Equations 2.2 and 2.3) only explain the general relationship between prices, resource quality and visits to sites in general. Site substitution cannot be evaluated with these models.

A multi-equation model can be estimated with a separate Vij equation for each of the J sites (Burt & Brewer, 1971) each with the price and resource quality explanatory variables for all sites. Again, resource quality variables must enter interactively. In this approach, the relationship between prices, resource quality and visits may vary across sites. Further, substitution effects of price or resource changes at one site on visits to the same and alternative sites can be directly estimated. Consumer's surplus estimates for resource changes is still complicated by the line integration problem (Freeman, 1979), because price or quality changes at one site affect visits to all other sites, and changes in the consumer's surplus at all sites, which must also be evaluated. The order of evaluating these changes in consumer's surplus may change the eventual benefits estimate.

A variation on the multi-equation approach, called the varying coeffiecient travel-cost model (Vaughan and Russell, 1982; Desvousges et al., 1983) has been used to focus upon valuing characteristics of the resource, such as fish catch. This model employs a two stage approach.

In the first stage Vij is regressed against prices and socioeconomic characteristics in a separate equation for each site:

$$\begin{aligned} Vi1 &= f_1\,(P1i,\ P2i \ldots P3i,\ Zi) \\ &\vdots \\ ViJ &= f_J(P1i,\ P2i \ldots P3i,\ Zi) \end{aligned} \qquad (2.4)$$

In stage two, the resulting estimates of $\partial V_{ij} / \partial P_j$ are pooled and regressed against the site characteristics at the corresponding site j. This allows the determination of the effect of changes in site characteristics upon visits and consumer's surplus at a site can be determined. An alternative second stage by Samples and Bishop (1980), called a varying Consumer's surplus model, was to estimate the consumer's surplus for each site from the stage one equation and, in stage two, regress these estimates against site characteristics for a direct relationship between consumer's surplus and site characteristics.

The Hedonic Travel-Cost Method

Brown and Mendelsohn (1983) have addressed the issue of valuing site characteristics by developing a "hedonic travel cost approach." In this approach recreationists are assumed to be willing to incur different levels of cost to recreate at different sites because of the different levels of the characteristics supplied at the sites. The combination of characteristics, costs, and socioeconomic characteristics of the individual can be examined, as in the property value approach, to determine the demand for the characteristics.

The hedonic travel cost approach asserts that, given fixed trip costs plus increasing costs associated with increasing expenditures in distance traveled and time spent, an individual will choose to travel farther away to recreate only if more distant sites provide, all else fixed, higher levels of desired characteristics. Therefore, by regressing travel costs from one point or origin to each of several sites on the characteristics at each site, a hedonic price function, which the authors label a value function, of characteristics is estimated (i.e., prices of characteristics are origin-specific, not site-specific). For each point or origin the marginal value of a unit of characteristic is the partial derivative of the value function, as in the hedonic approach. A separate hedonic value function is estimated for each point or origin to many alternative sites. The demand for the characteristics across all origins and destinations is then estimated by regressing the average level of characteristics demanded by different types of recreationists at different origins on the prices of characteristics for those recreationists.

Several concerns arise when reviewing the hedonic travel cost approach, the most important of which is that the method has never been closely related to economic theory. For example, the estimated versions of this model have utilized linear specifications of the hedonic price function, which implies constant marginal pricing of characteristics purchased. Further, the identification problem issue faced by all hedonic pricing methods also plagues this model (see Bartik and Smith, 1985; Brown and Rosen, 1982; Palmquist, 1984; Quigley, 1982 and Rowe and Chestnut, 1983 for additional discussion).

The Multinominal Logit Method

Another approach capable of dealing with both site substitution and valuation of resource characteristics is the multinominal logit approach (Morey, 1981, 1984) wherein the model estimates the likelihood a recreation trip will be taken to a given site/mode as a function of the costs and characteristics of each site/mode. The approach, as described in detail in Chapter 4, uses a probabilistic framework based upon the multinominal distribution and uses model specifications derived from specifications of utility functions. Exact consumer surplus estimates for changes in site availability or characteristics can be calculated for trips that are taken, but the effect of these changes on the probability of taking a trip is not directly addressed.

Contingent Valuation Methods

Survey methods can also be used to value changes in the availability of a site or to value changes in resource quality at a site. While travel cost models rely upon analysis of data on actual behavior under actual circumstances, survey methods, or contingent valuation methods (CVM), rely upon survey response to hypothetical situations. For example, they may ask individuals what their recreation travel behavior and expenditures would be given alternative hypothetical scenarios of environmental conditions at the site and at competing sites and evaluate the results using a contingent travel cost approach (Thayer, 1981), or ask individuals their willingness-to-pay to obtain or prevent a change, known as a contingent bidding approach (Cummings, et al. 1984). The strength of these approaches are they do not require actual changes in resource availability or quality to have occured in order to value the change, as required in travel-cost models. Their weakness is that they rely upon hypothetical responses to hypothetical scenarios. See Chapter 6 for more discussion on these methods for valuing marine recreational fishing.

2.2.3 General Issues in the Application of Travel-Cost Models

Many issues are of concern to the application of most all travel-cost models, several of which are briefly discussed below.

The Relationship of Travel-Cost Models to Economic Theory

The general travel-cost demand estimation procedure can, in concept, be related to economic theory of utility maximization subject to budget contraints. However, few applications have tied exact specifications of underlying utility functions to the functional form specifications of the travel-cost models. As a result, while considerable debate has surrounded the selection of a travel-cost model functional forms (Ziemer et al. 1980, for example), little has been done to relate these arguments to underlying utility theory. The notable exception is the multinominal logit work by Morey (1981, 1984) and the recent work by Bockstael et al. (1985). Bockstael et al. (Chapter 3) shows that apparently reasonable parameter estimates in some functional forms may actually imply an upwardly sloping income compensated demand function, suggesting the economic welfare measures may be meaningless.

Values Measured By Travel-Cost Models

Travel-cost models measure what are called consumptive user values, i.e., values held for the consumptive use of the resource. Values for nonconsumptive use, such as viewing of certain species, under water photography and the like, are usually not measured. Neither are preservation values for the protection of the resource into the future. Presentation values held by user have been found to be of substantial importance, with the ratio of preservation values to user values by users often averaging up to 50 percent for a diversity of natural resources (Fisher and Raucher, 1984). For the aggregate of all users and nonusers, presentation values may exceed use values by several orders of magnitude (Schulze et al., 1981). As a result, the user values estimated in this report may substantially understate the total value society holds for the protection of marine recreational fishing resources.

Defining the Experience and Related Variables

One of the problems of travel-cost methods is accurately and consistently defining the variables to reflect the experience being valued. For some individuals a trip may be one day and for others it may be for multiple days. Simply grouping together trips of different length leads to an inconsistent and somewhat ambiguious measure of use. Yet, using recreation days may be problematic because expenses and travel-costs per day may differ depending upon trip length. A related problem is allocating costs for trips that are multi-purpose, which may dramatically affect the consumer's surplus estimates (Johnson and Haspel, 1982).

Using Individual Versus Aggregate Data

Some authors have argued that data on individual participants, when available, is preferable to the use of zonal aggregate data due to increased statistical efficiency of the estimates (Brown and Nawas, 1973). On the other hand, Brown et al. (1983) later argue that the use of individual data will lead to biased parameter estimates in the travel-cost models. This issue is addressed in more detail in Section 4.3.

Valuing Travel and On-Site Time

Among the most important problems in applying the travel-cost method is the measurement of the value of time. Time spent traveling to and recreating at a site involves opportunity costs of producing the experience in terms of other activities forgone. Yet the time spent traveling and recreating may be part of the desired experience. Ignoring the time cost of travel will bias the price elasticity of demand and lead to understatements of WTP, and consumer's surplus. Because measures of travel time and travel distance are highly correlated, determining the value of travel time from within a model using methods proposed by McConnell and Strand, (1981) may lead to highly unstable estimates (Smith et al., 1983). Most authors have followed the lead of Cesario (1976) and valued travel time at one-third to one-half of the individual's wage rate when using individual data. When using aggregate data where income is unknown, fixed values per hour of travel time are generally assigned.

Most analyses assume the value of travel time is the same fixed percent of hourly wage for all individuals in the sample regardless of charateristics of the individual. It is more likely, however, that the value of travel time changes as a function of distance travelled, income, work schedule and other related variables. With a sufficient sample size this hypothesis could be tested by replicating the McConnell Strand approach (1981), which estimates the ratio (R) of travel time value to wages, for segments of the population with different characteristics, then regress R against those characteristics.

2.3 Consumer's Surplus Estimates From Related Studies

This section presents summary results of economic estimates of value from selected recreational fishing studies. The purpose of this summary is to provide evidence as to the order of magnitude of benefits that can be expected to be estimated in our study. These estimates are synthesized in Table 2.1. Numerous studies addressing this topic are not included as per day or per fish consumer's surplus estimates were not provided and could not be determined from available data.

Due to different locations and fishing activities, data types, different travel-cost and CVM models, and different implementation procedures, one would expect quite a diversity of estimated values. The table does suggest this is the case. The data also suggest that ocean Salmon and freshwater Steelhead fishing days are valued higher than other freshwater fishing. In fact,

Table 2.1

A Synthesis of Economic Estimates From Selected Recreational Fishing Studies

Study	Fishing Season	Location & Activity	Method	Value of Travel Time	Consumer's Surplus per day (1981$)[b]	Consumer's Surplus per fish (1981$)[b]
Brown et al. (1983)	1977	Oregon Steelhead	TC-zonal TC-micro-data	None[c] None[c]	$44[d] $123[d]	
Ziemer, et al. (1980)	1971	Georgia Warm Water	TC-micro-data	None[c]	$59[e]	
Vaughan and Russell (1982)	1979	Nationwide Fee Fishing Trout sites	TC-zonal	BEA Average	$30 (trout) $7 (catfish)	$.49 (trout) $.34 (catfish)
King and Walka (1980)	1980	Arizona Coldwater	TC-micro-data	None	$10	
Weitman & Haas (1982)	1979	Missouri Coldwater	TC-zonal	.35 of average wage	$20	
Huppert & Thomson (1984)	1979-80	California marine fishing from partyboats	TC-zonal	1/3 of wage 2/3 of wage	$13 $20	
Miller (1984)	1980	Selected States	TC-micro-data	1/3 wage	$20-$42	
Samples & Bishop (1983)	1978	Lake Michigan Trout and Salmon	TC-Zonal equation TC-Zonal multiequation	50% of wage	-- --	$.46[f] $9.40
Menz & Mullen (1982)	1976	Adirondack Freshwater	TC-Zonal TC-Multiequation	?	$23-$38 (w/o subtitution) $17-$30 (with substitution)	

Table 2.1 (continued)

Brown et al. (1980)	1977	Oregon				
		-Ocean Salmon	TC-Zonal	Avg. wage rate	-$78	
		-Freshwater Salmon			-$25	
		-Steelhead			-$36	
		Washington				
		-Ocean Salmon	TC-Zonal		-$75	
Crutchfield & Schelle (1978)	1978	Washington Ocean Salmon	CVM-WTP	--	$25	
			CVM-WTA	--	$56-$104[h]	
SMS Research (1983)	1983	Hawaii Ocean Fishing	CVM-WTP	--	$9-$85[g]	
			CVM-WTA	--	$178-$628[g]	
Donnolly et al. (1983)	1982	Idaho Steelhead	TC-Single Equation Zonal	$2.67/hr	$13.5[i]	--
					$28[j]	--
			CVM-WTP	--	$19[i]	$6.35[i]
					$48[j]	--

NOTES: TC = Travel Cost Method. CVM = Contingent Valuation Method, WTP = Willingness-to-pay, WTA = Willingness-to-accept. ? = not reported.

a. Table updated from Miller (1984).
b. Per angler unless otherwise noted. Values are typically based upon trips targeting this species.
c. Distance included as separate explanatory variable.
d. Value for trips rather than days.
e. Day value per household.
f. Value reported in personal correspondence.
g. Lower values for $1 starting bid. Higher values for $800 starting bid.
h. WTA range due to different cut-offs of maximum values accepted in analysis.
i. Based upon average 5.5 hr. recreation day of sample respondents.
j. Based upon 12 hour recreation day, as used in Forest Service management plans.

Charbonneau and Hay (1978) indicate that data from the 1975 Natural Hunting and Fishing Survey indicates recreation day values for marine fishing are 3.5 times those for freshwater fishing. Estimates of per day consumer's surplus for a day of marine recreation fishing range from $13 to $104 (in 1981$'s). In prior studies the per fish values are typically calcualted for trips targeting the species. In the current effort, per fish expected values apply to all trips prior to a site/mode and target species being selected.

3.0 DATA SETS AVAILABLE FOR THE ANALYSIS

This chapter discusses the primary data sets available for economic analysis of pacific coast marine recreational fishing. These data sets are compared to data desired to conduct a variety of travel cost model analyses. These comparisons serve to identify the strengths and limitations of each data set, problems that must be overcome to use the data sets for the stated project objectives and how survey instruments might be more effectively designed for the subsequent San Francisco Bay and Ocean Area Survey discussed in Chapter 6.

3.1 DESIRED DATA FOR A MARINE RECREATIONAL FISHING TRAVEL COST ECONOMIC ANALYSIS

3.1.1 Variables

To estimate a variety of travel cost models a survey must provide data on the characteristics of the marine recreational fishing experience and on those who choose to participate. The data must also be sufficiently detailed and accurate so that the measurement error in the data does not overwhelm the precision of the underlying relationship the travel cost models attempt to estimate. On the other hand, a survey instrument is constrained in terms of the number of questions that respondents can be expected to respond to before response fatigue, or increased participation refusal rates, become a problem. The types of data necessary to perform the majority of travel cost models reviewed in Chapter 2 can be grouped into four catagories:

1. General trip taking behavior.

2. Selected trip information.

3. Socioeconomic background information.

4. Contingent valuation questions on specific issues.

The variables considered to be of high and low priority in a pacific coast marine recreational fishing travel cost analyses are listed in Table 3.1. The table also identifies which data are available from the available survey instruments, as further discussed below. The variables are ranked as high or low priorities in terms of their importance in one or more travel cost models, the importance of their omission on the travel cost estimates and the availability of substitute data from alternative sources.

In terms of general trip taking behavior, high priority data include total trips per year, either by an individual or a group of individuals (from an origin zone) to determine control totals upon which to aggregate per trip values and to explain trip taking behavior across individuals; and the distribution of trips across modes and sites to determine how respondents choose among substitutes. The level of disaggregation defining the alternative sites visited needs to be sufficient to capture choices among sites based upon different characteristics of those sites, but not so detailed as to overwhelm the analysis. Similiarily, detailed data on the origin of the participants is needed to account for significant differences in travel costs to alternative sites for different individuals, and to account for differences in their socioeconomic characteristics. On the pacific coast, where the counties are often large and extend great distances inland, simple identification of the origin county results in significant error in estimating travel costs across individuals in the counties. In fact the population weighted average distance to fishing sites on the pacific coast may often exceed the distance from which 70 to 90 percent of trips originate. (See Chapter 6). Origin zip code or telephone prefix data is the preferred level of detail.

Trip length in days or hours, while critical for some travel cost analyses, can often be inferred from trip expenditure or travel distance data. In the case of pacific coast marine recreational fishing, most all trips were one day trips so that measurement error in this variable may have minimal impact on the analysis.

Table 3.1
Summary of Pacific Coast Marine Recreational Fishing Surveys

Variable	S/E	MRFSS Intercept	MRFSS Phone	NFWS
I. General Trip taking behavior				
High Priority				
1. Total # trips per year or season (by origin or individual)	X[a]	X[a]	X[a,b,h]	X
2. Distribution of trips by mode, season, site (issue of degree of resolution)		# instate vs. # out of state	X[h] (By season & county)	X[c]
3. Origin - zip code or telephone prefix of respondent - county of origin is less useful	X county	X county	X county	X[d] multi-group county
Lower Priority				
1. Distribution of trips by length - can be inferred from selected trip data, most trips are day trips.				X[g]
II. Data On Selected, typical, or last trip				
High Priority				
1. Site/area and mode	X	X	State or Substate	State or Substate
2. Preferred or targeted species	X	X		X[f]
3. Multiple or single purpose trip and % time and cost and split by activity				X[c]
4. Time spent on site		X		X[c]
5. Catch by species	X[h]	X[h]		X[j]
Medium Priority[e]				
1. Trip expenditures per resident - variable cost (very detailed)	X	X[g]		X[c]
2. Group size and composition	X			X[c]
3. Boat Rental, etc.	X	X		X[c]
4. Dist. from where stayed last night	X	X		
5. # days/trip				X[c]
Lower Priority				
1. Travel mode	X			
2. Perceived travel cost/mile				
3. Fish Deposition	X	X		
4. Knowledge of expected catch				
5. Type of gear used	X	X	X	
6. Actual travel distance from home	X			

Variable	S/E	MRFSS Intercept	MRFSS Phone	NFWS
7. # trips this specific site each year	X	X		
8. Facilities at site				
9. Rating of other site characteristics/reasons for fishing	X			
III. General Socioeconomic Data				
High Priority				
1. Income	X			
2. Employment status (FT,PT, retired, unemployed, student)	X			
3. Age		X		
4. Other experience measures	X			
5. Boat ownership				
Lower Priority				
1. Education family size				X
2. Reasons for fishing	X			
3. # fishermen in household			X	
4. Occupation				X
5. Ethnicity				X
6. Amount of vacation				
7. Capital Equipment				X

NOTES

a. Assume all trips are 1 day. # of trips by intercepted individual.
b. # of trips in last 2 months for selected species for telephoned individual.
c. Some similar questions for last 5 trips. Sites are state or substate areas which are too aggregate for most travel cost analyses.
d. Usually several counties per origin which is too aggregate for most travel cost analysis.
e. Many medium priority items can be obtained from other surveys (fish catch) or on an average basis ($ cost/day by mode) easier from other sources thus reducing required survey length. Obtaining costs also require party size and composition data.
f. Very few selected species included on the Pacific Coast survey.
g. Total only. Last year 1980.
h. Generally does not include Salmon or Striped Bass trips.

Data on a selected, typical or last trip is useful to obtain characteristics of alternative site/mode fishing trips. Similiarily socioeconomic characteristics of the participants help account for significant differences in participation behavior across individuals.

Trip expenditure data is required for the analysis, but is ranked a lower priority as average expenditures is often available from other sources. Furthermore, beyond a minimal threshold of travel costs and on-site costs for each fishing mode, trip expense are endogenously determined by the participant and require a separate explanatory analysis.

Other variables such as the respondent's perceived travel costs (versus the researcher's calculated average costs) may alter the travel cost price variable, but represents a refinement less significant than improvements in valuing travel time or in the choice of the travel cost method and functional form specifications. Further, the effect of variations in the estimates of per mile travel costs upon the economic analyses can be examined through a simple sensitivity analysis.

Contingent valuation method (CVM) questions are often included to address resource valuation issues for which existing data may be limited; where a second estimate, vis-a-vis the travel cost estimates, is desired; or where a valuation estimate is desired for alternative resource conditions not currently experienced by the participants. Additional discussion on CVM questions for valuing marine recreational fishing is found in Chapter 6.

3.1.2 Sampling Considerations

This section highlights several important characteristics of sampling procedures that affect use of survey data in a travel cost economic model. Detailed reviews of general sampling procedures are found in survey research handbooks (Rossi et al. 1983) and for marine recreational fishing on the pacific coast in NMFS reports (NMFS 1979, Hiett et al. 1983).

The first important characteristic is whether the surveys are conducted through a site intercept or residence intercept (mail or telephone) procedure. Site intercept surveys are generally preferred to obtain accurate data on site characteristics, such as average catch, site costs, etc. Site interviews may easily randomly select among known participants with selected site/mode characteristics. Site intercept surveys accurately obtain data on typical trip characteristics at the intercepted site/mode combination, but by oversampling frequent fishermen lead to biased estimates on trip taking behavior of the typical participant.[1] Finally, site and mode choice equations cannot be accurately estimated by most travel cost models with the intercept survey data as the percentage of respondents intercepted in different modes at different sites is determined by the survey procedures, which may not represent the actual underlying percentages unless accurate control totals are utilized with a uniform probability sampling procedure.

Site intercept surveys provide useful information not available through most telephone or mail surveys including a second estimate of the home residence distribution which allows the estimation of the percentage of trips originated from outside of the telephone or mail survey sampling areas. When these trips are included in the aggregation procedure the total number of estimated trips and economic values for the fishery resource increase beyond what can be determined by the telephone or mail surveys.

Telephone and mail surveys are generally more appropriate for determining rates of participation, average number of trips per participant and site mode distribution data. However, they are less likely to provide accurate site data, even for fish catch.

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[1] For example, let there only be two participants at a site in a survey time period; one who fishes 9 days and one who fishes one day. Assume a surveyor interviews whoever is fishing on two random days during a sampling period. Each day there is a .9 probability of interviewing the frequent participant and a .1 probability of surveying the infrequent participant. The expected value of the number of reported trips per fisherman during the survey period will be 8.2 (.9x9 + .1x1) rather than the actual average trips per fisherman of 5.

Sampling sizes are a second important sampling design concern for travel costs analyses. Insufficient sample sizes will limit the ability of a travel cost model to evaluate the probability of visiting a site or the importance of site chracteristics on the probability of selecting a site. For example, if the variance in the estimated mean level of a site attribute at each site exceeds the variance in the mean level of the attribute across sites, a statistical analysis will be limited in its ability to determine the effect of changes in this attribute on the demand for visits to alternative sites.

3.2 AVAILABLE SURVEY DATA

Four surveys provide data useful for analysis of pacific coast marine recreational fishing. They are the Marine Recreational Fishing (MRFSS) intercept survey, the MRFSS Phone survey, the MRFSS socioeconomic (MRFSS S/E) survey and the National Fish and Wildlife Service's National Survey of Fishing and Hunting (NSFH). The MRFSS surveys are conducted by the National Marine Fisheries Service (NMFS). The NMFS survey instruments for 1981 are included in Appendix A.

The MRFSS phone survey is conducted in six 2-month waves each year since 1979. Only residents of counties with a border within 25 miles of the pacific coast are included in the sampling population (this generally includes 60-95% of participants at fishing sites in the same county). MRFSS phone survey data was available for 1979-1981 for use in this analysis. The phone survey provides data to estimate participation rates (probability of participation and average number of trips) for residents of the sample counties. The survey also provides data on the distribution of trips in the last two months for selected fishing trips in terms of the county of the fishing site and the mode of fishing.

The MRFSS phone survey has several important limitations for this analysis. In most survey waves (the survey instrument has small changes from wave to wave) trip data was only obtained for finfishing trips other than for Salmon or Striped Bass. Therefore the estimates of trip taking behavior may be understated and misleading, especially for Salmon and Striped Bass trips on which more respondents are likely to travel greater distances and expend more resources when at the site than for many other species. As a result, use of this trip data may lead to an understatement of economic values for pacific coast marine recreational fishing. Other limitations include the absense of data on economic variables and target or catch data.

The MRFSS phone survey could, as it exists, be used with other secondary data on expected catch by site and mode, average trip costs by distance and mode, and origin specific socioeconomic data (using telephone prefixes) to examine travel cost models for non Salmon/Striped Bass finfishing trips by coastal county residents. These models could include individual observation or zone travel cost approaches. However, the number of usable observations limits the use of this data in a simultaneous equation approach or a multinomial logit model, which incorporate site and mode substitution. (See Table 3.2). Lack of precise data in site characteristics, miles traveled and trip length probably precludes the use the hedonic travel cost method with this data.

The MRFSS Intercept Survey has been conducted in six 2-month waves each year since 1979. Data was available from 1979 through 1981 for use in this analysis. The survey focuses upon the detailed estimation of fish catch and deposition by species by mode and by site. Other data collected includes number of trips to this site and to all sites for finfishing in the past year; number of hours fished and left to fish; and demographic data including county of origin, where they stayed last night, age and sex, but not income. Limited economic data, including miles traveled and expenses for the trip, were collected in 1979 and 1980 only.

Individuals were randomly selected at a site, and the sites and modes to be sampled were selected to be roughly proportional to total trips in different areas of the pacific coast.

Table 3.2

Sample Size Statistics - 1981 MRFSS Phone Survey

	California	Oregon	Washington	Total
# Counties Included	27	18	14	59
# Household Surveyed	2216	1063	1273	4552
# Anglers Surveyed	2218	1061	1323	4602
Surveyed Anglers*/county				
- Avg.	82	59	95	78
- range	9-216	11-104	34-218	9-218
total # trips*/avg. per county by mode of fishing				
- Manmade	1344/50	491/27	786/56	2621/44
- Beach & Bank	1285/48	650/36	439/31	2374/40
- Partyboat	892/33	515/29	728/31	2374/40
- Private/Rental Boat	1702/63	1074/60	1829/131	4604/78
- Unknown Mode	66/2.4	25/1.4	9/.6	100/1.7
Total All Modes	5289/196	2755/153	3790/270	11834/201

* In many households more than one angler was interviewed, yet several data records were deleted from analysis due to file structure and coding errors. This number represent the number of anglers for which data was processed. Each angler reported data on one or more trips (on average data on 2.5 trips was reported).

In an intercept survey, the data is representative of a typical trip, not a typical fisherman, which is appropriate for estimating fish catch. The sampling plan also called for the exclusion of fisherman readily identifiable as targeting Salmon and Striped Bass leading to very limited data on Salmon and Striped Bass trips and catch.

The major limitations of the MRFSS intercept survey instrument for use with travel cost models are that the origin data is more aggregated than desirable (telephone prefixes were not obtained in the pacific coast, nor were zip codes) limited economic data was obtained in only the first two years, the general exclusion of Salmon and Striped Bass trips may bias any analysis using this data, and limited trip distribution information. As a result of the limited trip distribution information and the intercept approach, some travel cost models would be unable to address site and mode substitution issues with this data. However, due to the substantial sample sizes (See Table 3.3) the multinomial logit approach used in this report may overcome these later problems. However, even the very large sample sizes are insufficient to estimate 2 month seasonal catch rates by mode and site combination with the degree of precision required to estimate useful seasonal travel cost models.

<u>The MRFSS S/E Survey</u> was conducted as an intercept and telephone follow-up with a limited number of the MRFSS intercept survey participants (See Table 3.4). While the survey gathered useful economic and socioeconomic data, such as miles traveled, trip expenditures and household income, it is of limited use in the proposed current effort. This is because of the very small samples and the lack of information allowing one to accurately infer selected fishing site and mode distribution probabilities by origin. Trip data was only obtained for the intercepted trip. Total trips in the last year to the intercepted site was asked as was total trips to all sites in the last year. As a result, simple travel cost models can be estimated with this data, but more complex models incorporating mode and site substitution cannot be accurately estimated. As with the MRFSS intercept survey limited information on Salmon and Striped Bass fishing was obtained.

<u>The U.S. Fish and Wildlife Service National Hunting and Fishing Survey</u> is conducted by telephone and in person every five years. This survey can be ruled out for the present analysis as, for purposes of confidentiality, both the origins of the fishermen and the fishing sites are grouped into six areas

Table 3.3

Sample Size Characteristics - 1981 MRFSS Intercept Survey*

Sites	Southern California	Northern California	Oregon	Washington	Total Pacific Coast
# coastal counties with intercept sites					
	6	13	7	14	40
# total observations /Avg. observations per county by mode of fishing					
Man-made	4,545/757	2,806/216	2,231/319	2,631/188	12,213/305
Beach & Bank	1,047/176	2,310/178	1,800/257	1,197/86	6,354/159
Partyboat	3,280/547	774/60	482/69	1,414/101	5,950/149
Priv-Rental	3,692/615	1,976/152	2,163/309	4,454/318	12,285/307
All Modes	12,564/2094	7,866/605	6,676/953	9,696/693	36,802/920

* Numbers represent usable data points. Some observations were deleted from analysis due to file structure problems and coding errors.

Table 3.4

Sample Size Characteristics - 1981 MRFSS S/E Survey*

	Southern California	Northern California	Oregon and Washington	Total Pacific Coast
# coastal counties with intercept sites	6	13	21	40
# total observations /Avg observations per county by mode				
Manmade	99/66.5	124/9.5	155/7.4	378/9.4
Beach & Bank	67/11.2	109/8.4	134/6.4	310/7.7
Partyboat	67/11.2	57/4.4	95/4.5	219/5.5
Private Rental	87/14.5	118/9.1	240/11.4	445/11.1
All Modes	320/53	408/31	624/29.7	1352/33.8

* Due to substantial amounts of missing observations on key variables, available sample sites for economic analyses are 30-40% smaller.

for all of California. This makes an economic analysis extremely difficult as the nearly all participants at a site area will come from within the same site area, but different individuals will travel anywhere from zero to several hundred miles to participate at locations within the same area.

3.3 SUMMARY OF THE STRENGTHS AND WEAKNESSES OF THE AVAILABLE DATA

The strengths of the available instruments are that accurate data can be obtained on expected fish catch by site and mode from the MRFSS intercept survey, accurate rates of participation (probability a household participates and average number of trips taken) can be obtained from the MRFSS telephone survey, accurate estimates of average expenditures by site and mode can be made with the MRFSS S/E survey, and the large sample size of the MRFSS intercept survey allows reasonable estimates of trip distributions from different counties of origin to different site/mode alternatives.

The most important limitations are the limited sampling of Salmon and Striped Bass fishing trips, limited sample sizes on several survey instruments reducing the ability to analyze site and mode substitution, the absense of economic data from most of the MRFSS instruments, and the lack of detailed information on the trip origin beyond county of origin. Application of most all travel cost models will be saddled, to some degree, with these limitation.

4.0 THE ANALYSIS PLAN AND SELECTED MODELS

This chapter discusses the overall analysis plan; the theoretic detail of the multinomial logit and the individual data single equation travel cost models used in the analysis; and practical details on how the data was used to define site and mode alternatives, fishing prices, expected catch rates and aggregate trip taking behavior.

4.1 THE ANALYSIS PLAN

The analysis was conducted in five steps:

1. Select the multinomial logit travel cost model and the 1981 MRFSS intercept survey to be used for all analyses. Select an alternative travel cost model using a single equation approach with individual data from the MRFSS S/E data. This provides a comparison between the results of the two travel cost models and allows the processing of the MRFSS S/E data to examine the importance of socioeconomic characteristics upon the demand for marine recreational fishing. It also dovetails with the required processing of the MRFSS S/E survey to obtain expenditure data by site and mode to be used in the multinomial logit analysis.

2. Define the level of disaggregation of fishing sites, species and origins; and define the travel costs variables.

3. Compare the concepts and results of the two travel cost models. Project resources allowed the empirical comparison for S. California in 1981 only, and only allowed limited estimation on the individual data single equation approach.

   The multinomial logit model was also estimated for Southern California with 1980 MRFSS intercept data to examine the stability of the estimated model parameters to year to year changes in characteristics of the fishing sites and changes in recreational behavior patterns. It should be noted that average catch of most species decreased dramatically from 1980 to 1981 (See Section 4.4 on estimating the total number of recreational trips.).

4. Conduct the entire pacific coast analysis with the multinomial model. While the multinomial logit model was initially estimated with Southern California data for comparison purposes and to debug the estimation process, the final Califonia model consisted of the whole state. This was done to take account of potential substitutions between Southern and Central California due to differences in available species. However, due to the design of the model, separate benefit calculations can be made for Southern and Northern California. Separate models are also estimated for Oregon and Washington.

5. Based upon the selection and application of travel cost models to the available data, design a revised instrument to be used in a survey of marine recreational fishing in the San Francisco Bay and Ocean Area (Chapter 6).

Model Selection

A model was desired that:

- Had strong theoretical foundations.
- Considers the substitution possibilities among sites and fishing modes.
- Includes as independent variables the costs of visiting all site/mode alternatives and the characteristics (expected fish catch) of all site/ mode alternatives.

- Leads to exact consumer surplus measures for the value of a trip, and for changes in the characteristics of available alternatives.

- Can be estimated with the available data.

The multinomial logit model using the MRFSS intercept data meets all of these criteria. Additionally, if data on socioeconomic characteristics of the participants were available, the multinomial logit model could incorporate this as well. Unfortunately, the only available data set with individual socioeconomic data, the MRFSS S/E survey, has an insufficient sample size to implement, with the desired degree of precision, the multinomial logit or other travel cost approaches that would deal with site substitution and characteristics valuation issues.

Other approaches could also have been selected, but were felt to be of less merit. For example, the single and multiple equation zonal travel cost model (Burt and Brewer, 1971) and the varying parameter model (Vaughan and Russell, 1982) could be implemented by determining the aggregate number of trips from origin zones (in this case counties) to alternative sites with the data from the MRFSS intercept and telephone surveys (See Section 4.4) and combined with MRFSS catch data at each site. However, because only the county of origin was identified in either the MRFSS telephone or intercept surveys, origin zones would have to equal counties, which would limit the number of observations in each equation (there would be a separate equation for each site in either of these approaches) to 59 or less, depending upon the state being examined. Individual data versions of these models could not be estimated due to the lack of sufficient trip distribution data for the sampled individuals. Even if these models were estimated, consideration of the line integration problem would cause additional complications with their application (Freeman, 1979), as might the relationship of the selected functional form to underlying utility theory (See Section 2.2.3).

The hedonic travel cost model (Brown and Mendelsohn 1983) faces the same problems in terms of limited sample sizes for implementing the procedure with aggregated dsta and insufficient available information to implement the procedure with individual data. Moreover, we have concerns that the approach, having not been strictly related or developed from underlying economic utility theory subject to budget constraints, may have unknown characteristics. Other concerns include the identification issue, which plagues many hedonic valuation approaches (See Page 2-7).

The multinomial logit model, discussed at length in the next section, has several advantages for use with the available data. By assuming that the site/mode selection for each trip is independent of all other trips, the method does not require seasonal trip distribution for each individual to address the issue of substitution across sites. The approach is based upon the specification of the utility function and, as a result, exact consumer's surplus estimates can be made without consideration of the line integration or other problems. This application of the multinomial logit method is not without it's own limitations. Most important, the model does not adaquately address issues concerning rates of participation and one may take issue with the specification of the utility functional form selected in this application.

As an alternative to the multinomial logit model, a simple single equation travel cost model using individual data from the 1981 MRFSS S/E survey is estimated for comparison purposes. The model was not selected for its theoretical or technical strengths, but selected because it represents the type of model that is estimated in many studies and because it used the individual socioeconomic data collected in the MRFSS S/E survey. Analysis with this data allows the investigation of the importance of socioeconomic characteristics on the demand for marine recreational fishing and allows the estimation of average expenditures per trip by mode and site for use in the multinomial logit model.

4.2 DETAILS OF THE MULTINOMIAL LOGIT MODEL

The multinomial logit model has been increasingly used to model recreational behavior in choosing among alternative recreation sites. Recent applications include estimates of the demand for Colorado ski areas (Morey 1981, 1984), and the estimation of the demand for alternatives sites to fish along Lake Michigan (Caulkins, Bishop and Bowes, 1984). The current application is unique in also using the technique to value changes in characteristics of sites.

4.2.1 <u>The Multinomial Logit Model</u>

To implement the model assume that the individual faces J x M alternative fishing sites and modes and will choose one at which to participate. Let the probability that the jm^{th} alternative is chosen be Π_{jm}, where $\sum_{j=1}^{J} \sum_{m=1}^{M} \Pi_{jm} = 1$

If $y = (y_{11}, y_{12}, \ldots, y_{iM}, \ldots y_{j1}, \ldots, y_{jm}, \ldots, y_{J1}, y_{J2}, \ldots y_{JM})$ is the outcome vector where y_{jm} is one if that alternative is chosen and zero otherwise and $\sum_{j=1}^{J} \sum_{m=1}^{M} y_{jm} = 1$, then the probability of observing the vector y is:

$$\prod_{j=1}^{J} \prod_{j=1}^{M} \Pi_{jm}^{y_{jm}} \tag{4.1}$$

If there are N individuals the liklihood function for the N outcome vectors is:

$$L = \prod_{i=1}^{N} \prod_{j=1}^{J} \prod_{m=1}^{M} \Pi_{jmi}^{y_{jmi}} \tag{4.2}$$

Where:

y_{jmi} = 1 if individual i chooses site j mode m,
y_{jmi} = 0 otherwise, and
Π_{jmi} = is the probability that individual i will choose alternative jm.

The logit model derives the Π_{jmi} from a random utility model (RUM) such that the probabilities are a function of the costs of visiting each of the side/mode alternatives and the characteristics of each of the site/mode alternatives.

Assume that the utility individual i receives if he chooses to fish at site/mode jm is U_{jmi} such that:

$$U_{jmi} = U(I_i, P_{jmi}, A_{jm1}, A_{jm2}, A_{jm3}, A_{jm4} \ldots A_{jm12}) + \varepsilon_{jmi} \quad (4.3a)$$

Where:

I_i is the individual i's budget for the period in which the trip takes place

P_{jmi} is the cost of a trip to site j mode m for individual i

a_{jmk} is the average catch rate for species k at site j mode m, k = 1,3, ..., 12.

ε_{jmi} is known to the individual but a random variable from the investigators perspective.

Three things to note about equation 4.3a are that a) it is a conditional indirect utility function wherein the utility is conditional upon the site and mode fished, b) it assumes utility is additive both across site/mode and visits, and c) U_{jmi} is a random variable. The logit model to be employed will specifically assume:

$$U_{jmi} = B_o I_i - B_o P_{jmi} + B_1 A_{jm1} + B_2 A_{jm2} + B_3 A_{jm3} + \ldots B_{13} A_{jm12} + \varepsilon_{jmi} \quad (4.3b)$$

Equation 4.3b implies the choice of alternatives is independent of I_i, i.e. there is no income effect, and the parameter B_o is the constant marginal utility of money.

Given this model, the probability that individuals will choose site j mode m is therefore

$$\Pi_{jmi} = \text{Prob}\ [U_{jmi} > U_{\ell ti}\ \forall \ell, t] \qquad (4.4)$$

The logit model assumes that the matrix of random variables ε_i has an Extreme Value Distribution. I.e. that the joint cumulative distribution function (c.d.f.) is

$$F_{\varepsilon}(\varepsilon_i) = \exp\left[-\sum_{j=1}^{J}\sum_{m=1}^{M} e^{-\varepsilon_{jmi}}\right] \qquad (4.5)$$

If one assumes that the random variables ε_{jmi} have an Extreme Value Distribution then it can be shown that

$$\Pi_{jmi} = 1 \Big/ \prod_{\ell=1}^{J}\prod_{t=1}^{M} e^{\left[-B_o(P_{\ell ti} - P_{jmi}) + B_1(A_{\ell t1} - A_{jm1}) + \ldots + B_{12}(A_{\ell t12} - A_{jm12})\right]} \qquad (4.6)$$

Where Π_{jmi} is the probability that individual i will choose site j mode m.

By substituting Equation 4.6 into Equation 4.2 and applying maximum likelihood estimation (MLE) techniques one obtains MLE estimates of the B parameters of interest. This is most easily done by maximizing the log of the likelihood function, which as a monotone transformation will lead to the same parameter estimates.

The log of the likelihood function is

$$\ln L = \ell = \sum_{i=1}^{N}\sum_{j=1}^{J}\sum_{m=1}^{M} y_{jmi} \ln \pi_{jmi} \qquad (4.7)$$

$$= -\sum_{i=1}^{N}\sum_{j=1}^{J}\sum_{m=1}^{M} y_{jmi}\left[\ell n \sum_{\ell=1}^{J}\sum_{t=1}^{M} e^{\left[-B_o(P_{\ell ti} - P_{jmi}) + B_1(A_{\ell t1} - A_{jm1}) + \ldots + B_{12}(A_{\ell t12} - A_{jm12})\right]}\right]$$

The lack of data on the MRFSS intercept survey respondents, except for data on their trip and their county of origin, is unfortunate but leads to a simplification of the likelihood function Equation 4.7. The lack of individual specific data requires one to assume all individuals from the same origin face the same catch rates and costs. Therefore $\Pi_{jmr} = \Pi_{jms}$ if individuals r and s are from the same origin county. In this case Equation 4.7 simplifies to (Proof available from the authors):

$$\begin{aligned} \ell n = \ell &= \sum_{i=1}^{N} \sum_{j=1}^{J} \sum_{m=1}^{M} y_{jmi} \, \ell n \, \Pi_{jmi} \\ &= \sum_{c=1}^{C} \sum_{j=1}^{J} \sum_{m=1}^{M} y_{jmi} \, \ell n \, \Pi_{jmc} \qquad (4.7a) \\ &= \sum_{c=1}^{C} \sum_{j=1}^{J} \sum_{m=1}^{M} y_{jmc} \left[\ell n \sum_{\ell=1}^{J} \sum_{t=1}^{M} e^{\left[-B_o(P_{\ell tc} - P_{jmc}) + B_1(A_{\ell t1} - A_{jm1}) + \dots + B_{12}(A_{\ell t12} - A_{jm12})\right]} \right] \end{aligned}$$

Where:

- c is the number of origin counties
- y_{jmc} is the total number of trips from county c to site j mode m and
- Π_{jmc} is the probability that a trip from county c will be to site j mode m.

4.2.2 Maximum Likelihood Estimation

The maximum likelihood estimation of the B parameters are found by maximizing the log of the likelihood function (4.7a) using a newton type search algorithm contained in the "Non-Linear Optimization Solver" program by Dr. Robert Schnabbel of the University of Colorado Department of Computer Science. It should be noted that the log likelihood function is globally concave so that the maximum located by the algorithm is the global maximum of the function.

4.2.3 Benefit Estimation with the Multinomial Logit Model

An objective of the analysis is to calculate consumer surplus measures of value for charges in the availability or quality of marine recreational fishing. This can be accomplished with the results of the multinomial model by letting

$P_i^o = \left[p_{jmi}^o\right]$ be the initial matrix of costs for individual i

$P_i^1 = \left[p_{jmi}^1\right]$ be the new matrix of costs for individual i

$A^o = \left[A_{jmk}^o\right]$ be the initial matrix of site/mode catch rates

$A^1 = \left[A_{jmk}^1\right]$ be the new matrix of site/mode catch rates

Hanemann (1982) has shown that for the multinomial logit model outlined above the individual's expected CV (and EV) associated with a change from (P_i^o, A^1) to (P_i^1, A^1) is:

$$CV_i = EV_i = \frac{1}{B_o}\left[\ell n\left\{\sum_{j=1}^{J}\sum_{m=1}^{M} e^{(-B_o P_{jmi}^o + B_1 A_{jm1}^o + B_2 A_{jm2}^o + \dots + B_{12} A_{jm12}^o)}\right\} - \ell n\left\{\sum_{j=1}^{J}\sum_{m=1}^{M} e^{(-B_o P_{jmi}^1 + B_1 A_{jmi}^1 + B_2 A_{jm2}^1 + \dots + B_{12} A_{jm12}^1)}\right\}\right] \quad (4.8)$$

The expected equivalent variation (EV) and compensating variation (CV) consumer's surplus measures are equal because the chosen conditional indirect utility function assumes there is no income effect. This specification was chosen because there was no income data.

Equation (4.8) can be used to calculate the expected per trip CV (and EV) associated with the elimination of fishing at any of the site/modes. For example, the expected CV (and EV) associated with the elimination of site ℓ mode t for an individual from county i is

$$CV_{i\ell t} = EV_{i\ell t} = \frac{1}{B_o}\left[\ell n\left\{\sum_{j=1}^{J}\sum_{m=1}^{M} e^{(-B_o P_{jmi} + B_1 A_{jm1} + B_2 A_{jm2} + \ldots + B_{12} A_{jm12})}\right\} - \ell n\left\{\sum_{j=1}^{J}\sum_{m=1}^{M} e^{(-B_o P_{jmi} + B_1 A_{jm1} + B_2 A_{jm2} + \ldots + B_{12} A_{jm12})}\right\}\right] \quad (4.9)$$

except for
$jm = \ell t$

One could, for example, use Equation (4.8) to calculate the expected CVs (and EVs) associated with the elimination of on-shore fishing opportunities due to an oil spill or use it to value Salmon fishing at a particular site.

Following Hanemann (1982) the derivation of Equation 4.8 proceeds as follows, given the linear additive conditional indirect utility function specified in Equation 4.3b. The <u>unconditional</u> indirect utility function for individual i is therefore

$$v_i = v(P_i, A, I_i, \varepsilon_i)$$

$$= \max\left[U_{11i}, U_{12i}, \ldots, U_{1mi}, \ldots, U_{j1i}, \ldots U_{jmi}, \ldots U_{J1i}, \ldots U_{JMi}\right]$$

$$= \max\left[U(I_i, P_{11i}, A_{111}, A_{112}, \ldots A_{1112}) + \varepsilon_{11i}, \ldots, U(I_i, P_{jmi}, A_{jm1}, A_{jm2}, \ldots A_{jm12}) + \varepsilon_{jmi}, \ldots, U(I_i, P_{JMi}, AJ_{MJ1}, A_{JM2}, \ldots, A_{JM12}) + \varepsilon_{jmi}\right] \quad (4.10)$$

The variable v_i is the utility obtained by individual i if he maximized his utility when confronted with the choice set (P_i, A, I). Note that v_i is deterministic from the individual's point of view but a random variable from the point of view of the analyst.

Since v_i is a random variable, one needs to work with its expected value to evaluate the expected welfare impacts of a charge from (P_i^o, A^o, I) to (P_i^1, A^1, I). The expected value of v_i is V_i where

$$V_i = V(P_i, A, I_i) = E\left[v(P_i, A, I_i, \varepsilon_i)\right] \quad (4.11)$$

$$= E\left\{\max\left[U_{11i}, U_{12i}, \ldots, U_{1mi}, \ldots, U_{j1i}, \ldots U_{jmi}, \ldots U_{J1i}, \ldots U_{JMi}\right]\right\}$$

The variable V_i is the <u>expected</u> maximum utility associated with the choice set (P_i, A, I_i)

Equation (4.11) can be used to define the CV and EV in the random utility framework. Define the CV and EV such that

$$V(P_i^1, A^1, I_i + CV) = V(P_i^o, A^o, I_i) \quad (4.12)$$

and

$$V(P_i^1, A^1, I_i) = V(P_i^o, A^o, I_i - EV) \quad (4.13)$$

Defined in this way, the CV is the compensation (or payment) associated with the change that would make individual i's <u>expected</u> max utility after the change the same as it was before the change. If (P_i^1, A^1) is preferred to (P_i^1, A^o) then the absolute value of CV_i is our <u>expectation</u> of the maximum amount individual i would pay to bring about the change. If (P_i^o, A^o) is preferred to (P_i^1, A^1) then CV_i is our expectation of the minimum amount individual i would have to be paid to voluntarily except the move.

Defined in this way, the EV is the compensation (or payment) associated with the initial state that would make individual i's <u>expected</u> maximum utility with out the change equivelant to his <u>expected</u> maximum utility with the change. If (P_i^1, A^1) is preferred to (P_i^o, A^o) then the absolute value of EV_i is our <u>expectation</u> of the minimum amount individual i would have to be paid to voluntarily forgo the change. If (P_i^o, A^o) is preferred to (P_i^1, A^1) then EV_i is our <u>expectation</u> of the maximum amount individual i would pay to stop the move.

Given U_{jmi}, Equation 4.3b and utilizing the CV and EV equations (4.12) and (4.13), Hanemann (1982) has shown that

$$CV_i = EV_i = \frac{1}{B_o}\left[V_i^o - V_i^1\right] \tag{4.14}$$

The term $[V_i^o - V_i^1]$ is the expected utility difference between the two states. From the conditioned indirect utility function (4.3b) we know that the variable B_o is the constant marginal utility of money so $(1/B_o)$ is the inverse of the marginal utility of money. Therefore, multiplying $[V_i^o, - V_i^1]$ by $(1/B_o)$ converts the utility change into a money metric of the utility change. Again, the CV equals the EV because the marginal utility of money is a constant.

If one assumes, that ε_{jmi} in the conditional indirect utility function (4.3b) has an Extreme Value Distribution, and the logit model holds, then it can be shown that,

$$V_i^o = B_o Y_i + \ell n \sum_{j=1}^{J} \sum_{m=1}^{M} e^{(-B_o P_{jmi}^o + B_1 A_{jm1}^o + B_2 A_{jm2}^o + \ldots + B_{12} A_{jm12}^o)} \tag{4.15}$$

and that

$$V_i^1 = B_o Y_i + \sum_{j=1}^{J} \sum_{m=1}^{M} e^{(-B_o P_{jmi}^1 + B_1 A_{jm1}^1 + B_2 A_{jm2}^1 + \ldots + B_{12} A_{jm12}^1)} \tag{4.16}$$

If one plugs Equation 4.15 and Equation 4.16 into Equation 4.14 one obtains Equation 4.8.

4.3 DETAILS OF THE INDIVIDUAL DATA SINGLE EQUATION MODEL

4.3.1 The Model

A simple travel cost demand equation is estimated using individual data pooled across all site/modes. The number of days an individual spends at a particular site/mode (reported on the MRFSS S/E survey) is assumed to be a function of the cost of visiting that site/mode, catch rates at the site/mode and total number of days fished during the year and socioeconomic variables.

$$Y_{jmi} = y(p_{jmi}, D_i, a_{jm1}, a_{jm2} \ldots a_{jml}, Xi) + e_{jmi} \qquad (4.17)$$

Where:

Y_{jmi} = the predicted number of trips to site j mode m for individual i.

p_{jmi} = the cost of a one-day trip to site j mode m for individual i.

a_{jmk} = the expected catch rate at site j mode m for species k, k=1, 2,...,12.

D_i = total number of days individual i fished during the year (used as an avidity measure).

X_i = socioeconomic characteristics of the individual.

e_{jmi} = a normally distributed random error.

Since the characteristics of the sites are included as independent variables, this equation explains each individual's demand for visits to individual site/mode alternatives as a function of the site's and individual's characteristics.

This model is a special case of Equation 2.1, where, however, only trips to one site are known and the characteristics and prices of substitutes are not considered. While simplistic, the model is not dissimilar from analyses that have been conducted in the past (Gum and Martin, 1975 Ziemer et al., 1980) and are still being conducted (Miller, 1984).

There are several important limitations with the model. Most important, the model is not consistent with the budget constraint in a constrained utility maximization problem. If one uses Equation 4.17 to estimate demand for total trips across all sites by individual i, Di*, it may (and in fact does) exceed Di for many individuals. Further, the model does not explicitly consider substitution possibilities among site/mode alternatives due to the exclusion of variables or the characteristics of alternative site/modes. However, because Di does not change with changes in y_{jmi}, the model implicitly requires that, for example, as y_{jmi} decreases, trips to other site/mode alternatives must increase to hold Di constant. Because the data is defined at a very fine level of disaggregation (piers, beaches, etc.) rather than county wide, one might expect the model to overstate consumer's surplus losses for degradation or elimination of such narrowly defined site/mode alternative. Again, this is because the model does not directly account for substitution to alternatives, either to a different mode at the same site or other nearby sites.

Since the work of Ziemer et al. (1980) the functional form specification of single equation travel cost models has received increasing attention. In general the specification of this model with, all sites in one equation, implicitly assumes that the value of incremental catch and costs is the same at all sites. The model is estimated with a semi-log specification, which has received recent strong support (Ziemer et al., 1980; Desvousges et al., 1983; Strong, 1983; and Huppert and Thomson, 1983, among others) and is used here. A simple linear specification is also estimated, which assumes that price, catch rates and socioeconomic variables are independent in determining trips to any one site.

Heteroskedasticity corrections have been shown to be important in single equation travel cost models (Rosenthal and Anderson, 1984, Strong 1983, Christensen and Price 1982, Brown and Loomis, Huppert and Thomson, 1984, among others) but due to limited resources and our focus on the multinomial logit model, such corrections are not attempted.

4.3.2 <u>An Aside on The Issue of Using Individual Versus Zonal Aggregate Data</u>

While some authors have asserted that using individual data may lead to more efficient estimates due to the increased degrees of freedom in the sample (Brown and Nawas, 1973), many recent researchers have returned to the use of zonal aggregates based upon the arguments of Brown et al. (1983). Brown et al. (1983) argue that use of individual data leads to biased estimates of travel cost estimates and overstatement of consumer's surplus estimates. Unfortunately, they present their case with an example rather than economic or statistical theory and, likewise, present an ad-hoc correction procedure to be used with individual data. While the estimates of the individual data single equation model are a secondary importance in this report, the arguments of Brown et al. (1983) have received such attention by practitioners that they merit additional theoretical comment. Due to the focus of this effort on the multinomial logit model, for which these comments do not apply, the corrections suggested in this section are not applied to the individual data single equation travel cost model as would be desired. See also Bockstael et al. (1985) for an alternative discussion of this problem.

Following Judge et al. (1982, pg.520) Assume that the individual j's true demand function for a site is:

$$\begin{aligned} Y_j &= a + Bp_j + e_j \quad \text{if } a + Bp_j + e_j \geq 0 \\ &= 0 \quad \text{otherwise} \end{aligned} \tag{4.18}$$

Where:

Y_j = the number of trips individual j takes to the site.
p_j = the parametric and non-stochastic cost of the trip for individual j.
e_j = a random error assumed to be distributed $N(0,\sigma^2)$.

Preferences are defined over both positive, zero and negative Y_j, but only non-negative quantities can be expressed in the market place.

Assume one takes a random sample of T individuals from the population of all individuals who have the same identical demand function and let S be the number of individuals in the sample of size T that had zero visits to the site. The sample N = T-S is therefore a random sample of all individuals in the population who visited the site at least once. The sample T is referred to as a censored sample because the negative values of the dependent variable

(Y_j) are not observable even through Y_j is negative for some observed values of the independent variable p_j. The sample N is referred to as a truncated sample because the independent variable p_j corresponding to the nonpositive Y_j is also not observed.

If one estimates the parameters a and B using ordinary least squares with either the censored sample T or the truncated sample N, the parameter estimates will be biased and inconsistent (Judge et al., 1983 page 527).

With a truncated sample N, the bias arises because:

$$E[Y_j | p_j, Y_j \geq 0] = a + BP_j + E[e_j | Y_j \geq 0] \quad j = 1,2... (T-S) \qquad (4.19)$$

If the expected value of the error term (the second term on the RHS of (4.19)) were zero there would be no bias; but the expected value of the error term is greater than zero because only positive Y_i are sampled. Most recreational samples are truncated samples of the population; i.e. only users are sampled. When the sample is truncated $e_j > -(a + Bp_j)$ and the distribution of the e_j is not symmetric or centered on zero. The mathmatical expectation of e_j is positive and OLS estimates of a and B obtained with the truncated sample N will be biased and inconsistent.

The probability distribution function (pdf) of this truncated normal distribution is:

$$f(e_j | e_j \geq -(a + Bp_j)) = \frac{f(ej)}{\int_{-(a + B^*p_j)}^{\infty} f(t)dt} \qquad (4.20)$$

The area under $f(e_j)$, $\int_{-\infty}^{\infty} f(t)dt$, equals 1, but the area under $f(e_j)$ to the right of $-(a + Bp_j)$, $\int_{-(a + BP_j)}^{\infty} f(t)dt$, is less than one. Therefore, dividing $f(e_j)$ by the denominator on the RHS of equation 4.20, which is less than one, shifts up the density function such that the area under the pdf of the truncated normal (Equation 4.20) equals 1. Note that $E(e_j | e_j > -(a + Bp_j) > E(e_j)$. As a result, the observations from the sample of N individuals is scattered around $E(Y_j | Y_j > 0)$ rather than the true regression line $a + Bp_j$ and the ordinary least squares regression estimation of and B will be biased and inconsistent such that consumer's surplus is overstated.

Brown et al. suggest that unbiased estimated of a and B can be obtained by estimating a and B with "zonal data" rather than the truncated sample of individual observations N. They create the "zonal data" by multiplying each Y_j in the sample N by the sampling rate (3000 in their example) divided by the population of the origin zone for the j^{th} observation; i.e., the new dependent variable is m_j where $m_j = 3000Y_j/Pop_j$. Define N as the sample of the zonal observations. Using the sample N. Brown et al. obtain the OLS estimates of $m_j = a + BP_j + v_j$ and suggest that these OLS estimates are unbiased estimates of a and B. This is incorrect; the expected value of v_j, like the expected value of e_j, is still positive and the OLS estimates are still biased and inconsistant. This weighting scheme cannot eliminate the bias because it does not consider the basic truncator problem.

However, weighting all the observations by $(3000/Pop_j)$ will reduce the bias if distant population zones were more populated than near zones (as in the Brown et al. example); the line $E(m_j | Y_j > o)$ will lie below the line $E(Y_j | Y_j > o)$. But if distant population zones are less populated than near zones (as is often the case with Marine Recreational Fishing on the Pacific Coast) the Brown et al. weighting scheme will increase the bias.

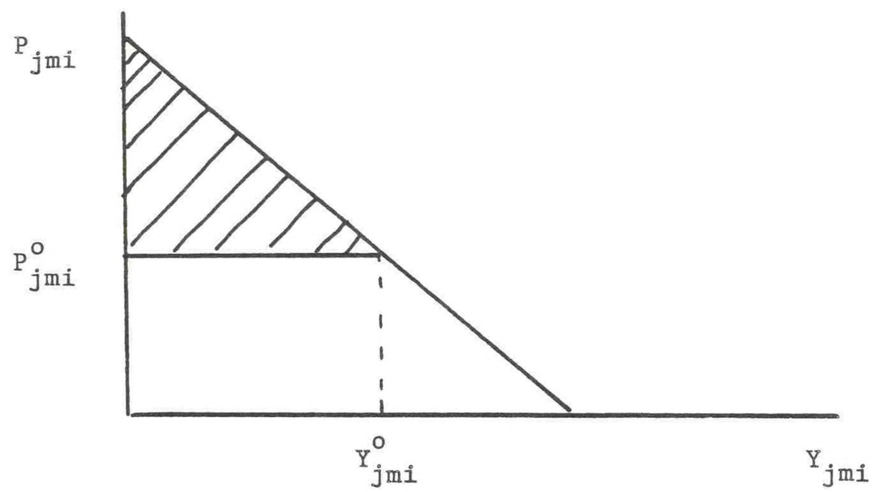
Using the sample of N individuals, estimates of a and B can be obtained that are consistent, asymptotically normal and asymptotically efficient by applying a technique developed by Ameniya (1973) and applied by Hausman and Wise (1976). To our knowledge the Ameniya technique has not been applied to truncated recreation samples. However, all traditional attempts to obtain an unbiased estimate of the recreational demand function for a site should consider this problem if the sample is truncated. For example, the estimated coefficients in section 4.3.1 will be biased because the sample is truncated, but not accounted for. The truncation problem doesn't apply to the multinomial logit model because the model focuses upon choices among alternatives rather than the choice whether to participate or not and at what level.

4.3.3 Benefit Estimation with the Single Equation Model

For the linear regression model, the consumer's surplus for individual i associated with visits to site j mode m is approximated by the shaded area in Figure 4.1.

Figure 4.1

Consumer's Surplus with a Linear Demand Curve



P^o_{jmi} is the initial cost individual i faces for a trip to site j mode m.
Y_{jmi} is trips to site j mode m for individual i.

Calculation of the consumer's surplus and consumer's surplus per trip with the linear demand curve is straightforward.

In the semi-log specification, the demand curve is asymtotic to the price axis and consumer's surplus (CS) is defined by Equation 4.21 where P_{jmi} is the price to participate at site j mode m for individual i.

$$CS = \int_{P^o_{jmi}}^{\infty} f(P_{jmi})dP_{jmi} \qquad (4.21)$$

It has been shown (Strong 1983) that this integral can simply be evaluated as CS $= -Y^o jmi/B$, where B is the coefficient on the price variable on the model. As a result, the consumer's surplus per trip; -1/B, is the same for all individuals.

4.4 APPLYING THE DATA TO THE MODELS

4.4.1 Definition of Fishing Sites, Modes and Fish Catch

The available level of detail on fishing sites varies by survey instrument. Most instruments provide only the county of the fishing site. The MRFSS intercept survey provides data for many sites within each county. The MRFSS intercept survey data would generally provide more detail than merited in the travel cost models, especially in models that are to cover regions as large as all of California, Oregon and Washington. Therefore sites were defined as counties along the pacific coast, except in Southern California where macro-sites were defined to more accurately reflect population density and fishing site characteristics. Figures 4.2 through 4.4 provide sketch maps of the counties along the pacific coast.

Following the MRFSS surveys, four fishing modes were defined as fishing from:

- o Beachs and Banks,
- o Man-made Structures
- o Partyboats and charter boats, and
- o Private or rental boats.

In some analyses the first two modes are combined and referred to as shore or on-shore modes and the latter two combined and referred to as boat or off-shore modes.

The MRFSS intercept survey collects catch data at a level of disaggregation beyond what a travel cost model can incorporate. Therefore, species were lumped together into 13 groups, as listed in Table 4.1, generally according to biological similarities.

Figure 4.2

California Coastal Counties and Southern California Macro-Sites

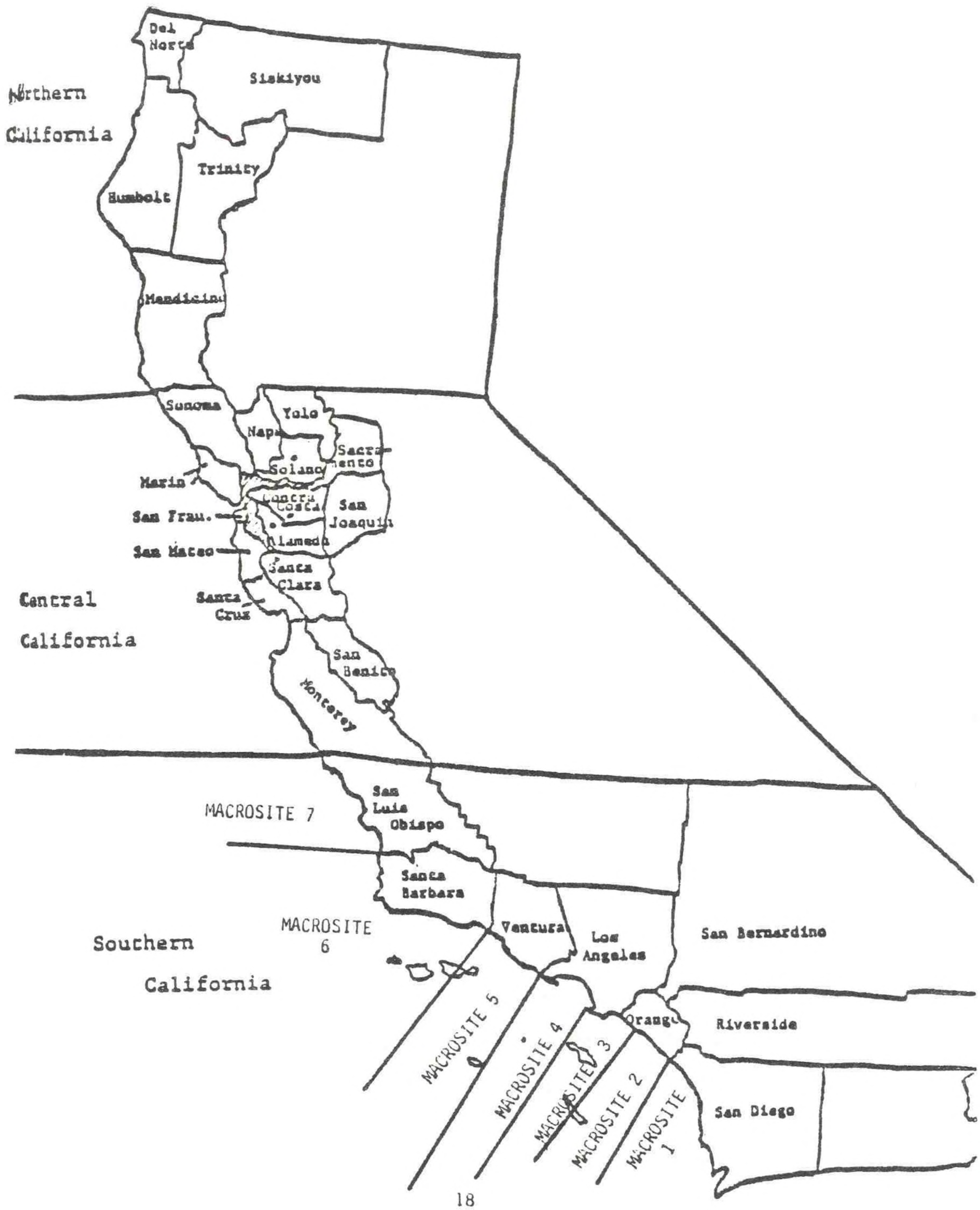


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Figure 4.3

Oregon Coastal Counties

Figure 4.4

Washington Coastal Counties

Table 4.1

List of 12 Species Groups

Species Group #	Species Included
1	Coastal Pelagics - Bonito, Pacific/Green & Jack Mackerel, Barracuda
2	Albacore
3	Tuna - Skipjack, Bluefin, Yellowfin, Bigeye Tuna, Yellowtail Other Tuna-like Species
4	Salmon, Trout
5	Swordfish & Billfish
6	Perches
7	Smelt & Grunion
8	Flatfish - Halibut, Sanddab, and Other Flatfish
9	Bass - Giant Sea Bass, Calico/Kelp Bass, Barred Sand Bass Spotted Sand Bass, Striped Bass
10	Rockfish and Bottomfish - Cow Cod, Red Rockfish, Other Rockfish, Lingcod, White Sea Bass, Other Croaker, Sculpin, Sablefish, Other Bottom Species
11	Sturgeon
12	Other Surface Species, Sharks, Skates, Rays & Eels
13	Fish caught but were unidentified

4.4.2 Measuring Expected Fish Catch

Average actual catch per trip by species by mode and macro-site is used as the measure of expected catch on a typical trip. Each model includes catch rate data only for these species generally targeted and caught at the study sites and where there is variations in catch rates across sites. Average catch was determined for each species group at each site for each fishing mode using the data from the MRFSS intercept surveys. Three average catch measures were defined: 1) total catch by species at a site divided by fisherman at the site; 2) total catch by species at a site divided by fisherman catching that species, and 3) total catch by species at a site divided by fisherman targeting the species. Average catch rates by those targeting a species (measure 3) are used for these site/mode combinations where the species is frequently targeted. For example, in Southern California the measure of per trip fish catch rates for species groups 9, 10 by boat modes, species group 8 by private boat mode, species group 6 by shore modes and species group 1 by all but the beach and bank mode use average catch for those targeting the species (pressure 3). The measure of average per trip catch for all other specie mode combinations is measure number 1.

In calculating the average catch data the actual average reported catch rates were adjusted by the percent of the trip's fishing time that had been completed. For example, all of the boat trip respondents were interviewed at the completion of the fishing trip, while the shore mode respondents were frequently interviewed while fishing was still in progress. Respondents reported the amount of time they had fished and the amount of time they expected to continue fishing. This information was used to adjust the average per trip catch rate data.

Due to small sample sizes of intercepted anglers for whom Salmon catch data was recorded, alternative estimates of average catch rates of Salmon were used based upon data from the individual states. In several cases, this data from the state was not at the level of detail of our analysis in terms of average catch by mode and site. In cases where this data was missing, average catch data was based upon the most similar mode/site alternative for which estimates were available.

In the travel cost models, only those species targeted and/or caught in the study region are included in a specification. For example, Flatfish are not included in the Washington and Oregon models.

4.4.3 Defining Travel and Site Costs

The travel costs of trips from county i to site j mode m (P_{jmi}) in the multinominal logit models is defined as:

$$P_{jmi} = 2(D_{ij})*.112 + 2 * (D_{ij}/40)*3.35 + S_{jm} \qquad (4.22)$$

where:

P_{jmi} = the price of taking a trip at site j mode m for individuals from origin i.

D_{ij} = The road miles distance from origin i to site j measured from the population center of county i to the nearest coastal point in site county j.

S_{jm} = the average on-site costs at site j mode m.

.112 = the per mile cost of operating a vehichle in 1981 from the Department of Transportation (1982). American Automobile Club operating cost estimates for 1981 (AAA, 1981) range from $.0745 to $.1333 per mile.

40 = the assumed average travel speed of 40 mph.

3.35 = the 1981 minimum wage per hour.

The first term in Equation 4.22 equals the vehicle costs of travel. The second term represents the value of time in transit, valued at the minimum wage. As individual data was generally not being used, the same value of travel time was used for all participants. The sensitivity of the economic estimates to alternative estimates of the average value of travel time is discussed in Chapter 5. On-site costs include partyboat fees, boat, pier fees, equipment rental, fish cleaning and lodging. A night of lodging was assumed to be required for distances in excess of 150 miles one way, two nights were assumed for distances exceeding 300 miles, and so forth. The average per night lodging costs in Southern California were $16.70. Similar values were calculated for Northern California ($14.71), Oregon ($19.52) and Washington ($24.69). The average on-site costs, net of lodging are reported in Table 4.2 and were derived from the 1981 MRFSS S/E survey.

Table 4.2

Average Per Day On-Site Costs by Model and Site

Mode	Southern California	Northern California	Oregon	Washington
Beach and Bank	$4.76	$3.98	$2.87	$1.74
Man-Made	$4.12	$3.55	$3.87	$2.28
Partyboat	$32.21	$45.55	$52.80	$46.28
Private/Rental	$18.59	$20.79	$22.83	$13.64

Source: 1981 MRFSS S/E Survey

*Costs include partyboat fees; equipment rental; pier fees; bait; fish cleaning, processing and packing; tolls and parking; and boat rental and fuel.

In Washington the travel costs and the average travel time was adjusted to reflect the required use of ferrys to get between some origins and destinations.

Travel costs in the single equation individual data models is described by Equation 4.22 except the \$3.35 average value of travel time is replaced by one-third of estimated hourly wage (yearly income/2080) for each respondent using the reported income data in the MRFSS S/E survey. In addition D_{ij} is the distance from home as reported by the respondent in the MRFSS S/E survey.

4.4.4 Estimation of The Total Number of Marine Recreational Fishing Trips in 1981

Data from the MRFSS telephone and intercept surveys was used to estimate the total number of trips for pacific coast marine recreational fishing in 1981. The multinomial logit models were estimated separately for trips from counties in California to sites in California, from counties in Oregon to sites in Oregon and from counties in Washington to sites in Washington. To aggregate the per trip values estimated in these models, estimates of trips from each county in a state to sites in the same state are required. However, in each state a substantial portion of trips are taken by participants from out of state, which must also be accounted for when determining aggregate economic values.

From the MRFSS telephone survey one can calculate total trips from a county to in-state destinations for coastal counties, but cannot determine total trips originating from non-coastal counties or originating from out of state. On the other hand, the MRFSS intercept survey gives an accurate picture of the distribution of where trips originate at any give site/mode alternative, but does not directly provide estimates of total trips from which to estimate total trips from any origin. However, together the two surveys provide the desired information.

Procedure

The estimation of aggregate annual trips by origin in 1981 followed a 6 step procedure.

1. The 1981 MRFSS phone survey was used to estimate the annual number of trips by mode originating in each "coastal" county included in the telephone survey sample plan. For each coastal county, the estimate of trips originating from that county were made separately for each of the six survey waves during the year and then added. For each wave the number of trips was calculated as the probability that an individual in a household participated in marine recreational fishing in the last two months times the average number of fishermen participating per participating household in the last two months times the average number of trips in the last two months per participating fisherman times the estimate of households in the county. 1980 census data was used to estimate the number of households, which will lead to an understatement of total trips taken.

2. Based upon the distribution of trips from the telephone survey, the estimated total trips from a region (S. Calif., N.Calif., Oregon and Wash.) were distributed to destinations in the same four regions. The aggregate trips from each origin region to each destination region were also allocated by fishing mode using the sample proportions in the telephone survey. These distributions of trips were calculated on a regional basis (rather than by counties) due to the small sample sizes upon which these estimates would have had to have been based if made on a county by county basis.

In summary, steps 1 and 2 provided estimates of total trips originating from each coastal county, the number of these trips that were to destinations in the same region and to other regions, and the number of these trips that were taken by each fishing mode.

3. The 1981 MRFSS intercept data was analyzed separately for each region and mode. For each region and mode, the number and percent of intercepted trips was calculated for participants from each coastal county in the same state, participants from non-coastal counties in the same state, participants from the other pacific coast states, and for participants from other states.

4. The estimated number of trips by mode by participants from same state coastal counties (Calculated in Steps 1 and 2.) was divided by the percentage of intercepted trips by mode by state (Step 3) to estimate the total number of trips , by mode, taken to each region. For example, if there are 2 million trips from Oregon Coastal counties to fish from private boats at Oregon sites (calculated from the MRFSS telephone survey in Steps 1 and 2) and two-thirds of the private boat trips intercepted at Oregon sites (from the MRFSS intercept survey in Step 3) are taken by Oregon Coastal county residents, then there are an estimated 3 million total trips to Oregon sites to fish from private boats.

5. Estimated total trips from California, Oregon and Washington non-coastal counties to destinations in the same state, and estimated total trips from out of state to destination in California, Washington and Oregon were calculated next. This was done by taking the estimate of total trips in a region by mode (Step 4) times the percent of trips by site/alternative originating from non-coastal counties or from out of state (Step3).

6. At this point the estimates of trips to out-of-state destinations based upon the telephone survey were usually less than the same estimate based upon the intercept survey. In part this was due to differences in the sampling methodologies, and in part because trips to out-of-state destinations from non-coastal counties are not captured in the telephone survey or in the above steps. Differences in these estimates were reconciled and allocated across counties generally in a fixed proportion for all counties, except for counties along state borders, especially along the Columbia River which were allocated higher percentages of the residual out of state trips. These adjustments usually affected the estimates of trips from a county, or trips to a region, by between 0 and 3 percent. Minor rounding errors of less than 1% were ignored.

Caveats

The above procedure is subject to some errors and biases. The most significant errors and biases are due to small sample sizes in the phone survey and the selection of the MRFSS intercept sites, which is most likely to affect the estimates of total trips for small counties, the estimates of trips taken to out of state destinations and the estimates of trips originating from out of state. The use of 1980 Census data on number of households will likely lead to an underestimate of total trips taken.

While the ERC calculations largely overcomes biases due to the MRFSS intercept survey procedure of not surveying fishermen participating in different fishing modes in the proportion that those trips occur (See Table 4.3), it cannot overcome biases that may occur due to unrepresentative selection of fishing sites in the MRFSS intercept survey, if any exists.

Results

The estimated total trips for marine recreational fishing are summarized in Table 4.4. Seventy three percent of all trips were taken to destination in California, with roughly two-thirds of those trips to destinations in southern California.

TABLE 4.3

Estimated Percent of Trips by Mode

	ERC Estimate/Phone Survey Estimate/MRFSS Intercept percent		
		DESTINATION	
FISHING MODE	California	Oregon	Washington
Beach and Bank	24.0/24.5/16.4	22.0/23.5/27.0	12.2/11.7/12.3
Man-made	23.0/23.4/36.0	19.1/20.0/33.4	18.9/20.7/27.1
Party/Charter Boat	22.1/20.6/19.8	22.3/17.5/7.2	30.7/19.3/14.6
Private Boat	30.9/31.5/27.8	36.6/39.0/32.4	38.2/48.3/46.0

*1981 trips. ERC estimate based upon all trips including those originating from in-state and out-of-state. Phone survey estimate for those participants from in-state coastal counties. MRFSS intercept percentages are actual survey percentages.

Table 4.5 allows comparison of the estimates of 1981 total trips made in this report to those made for 1980 (CIC Research, 1983), and to alternative estimates made for 1981 (NOAA 1983). The alternative estimates for 1981 could not be used here as they were only made on an aggregate basis, while estimates of trips from each county to destinations in the same state were required for our analysis. Attention is called to two findings reported in the table. The first is that trip taking in Southern California decreased dramatically in 1981. The second is that the ERC and Market Facts estimates for 1981 are substantially different in Southern California. We address these issues in turn.

TABLE 4.4

Summary of the Number of Pacific Coast Marine Recreational Fishing Trips in 1981*

	Trips Originating From:				
	California	Oregon	Washington	Other States	Total
Trips with destinations to:					
California	9,758,500	9,900	7,300	406,600	10,182,30
Oregon	70,700	951,900	40,400	57,500	1,120,500
Washington	34,800	90,100	1,673,700	166,700	1,965,300
Total	9,864,000	1,051,900	1,721,400	630,800	13,268,100

*Energy and Resource Consultants, Inc. calculations based upon 1981 MRFSS Telephone and Intercept Surveys. See Text.

TABLE 4.5

Comparisons of Estimates of Total Marine Recreational Fishing Trips on The Pacific Coast

Year/Source	Destination of Trip			
	Southern California	Northern California	Oregon	Washington
1980 (Heitt et al., 1983)	9,084,000	3,379,600	1,070,285	1,121,039
1981 (Energy and Resource Consultants, Inc.)	6,777,800	3,404,500	1,120,500	1,965,300
1981 (NOAA, 1983)	5,059,000	2,893,000	1,091,000	1,881,000

Year to year variations in trip taking behavior is not uncommon and can usually be related to average fish catch and general economic conditions. In Southern California, the average catch of every major species, except Bass, decreased between 1980 and 1981 based upon MRFSS survey data for those year. For example, depending upon mode of fishing, average Coastal Pelagic catch decreased by 12 to 36 percent, average Perch catch decreased by 39 to 52 percent, average Flatfish catch decreased by 47 to 80 percent and average Rockfish and Bottomfish catch decreased by 3 to 79 percent. Average Bass catch increased by 14 to 24 percent. In Washington, state game and fish reports, once corrected for different reporting structures, indicate average Salmon catch increased by 7 to 12 percent between 1980 and 1981. These data indicate that changes in fishing conditions in terms of expected catch may well explain differences in participation rates across years in Southern California and Washington.

Turning to differences between the estimated 1981 trips, little can be concretely said. The ERC calculations procedure is laid out above and all numbers rechecked. The NOAA numbers are presented with limited supporting documentation. The NOAA numbers suggest a 46 percent decrease in trips to Southern California and a 14 percent decrease in trips to Northern California, while the ERC numbers indicate a 25 percent decrease in Southern California and a slight (2%) increase in Northern California. We have found no evidence to suggest either estimates are more appropriate than the other.

5.0 RESULTS OF THE TRAVEL COST MODEL ANALYSES

5.1 MULTINOMIAL LOGIT MODEL ESTIMATION AND RESULTS

5.1.1 Model Estimation

The multinomial logit model was estimated separately for California, Oregon and Washington. For each state, three model variations were estimated;

- A null model version, which assumes the individual randomly allocates trips among the J x M site/mode alternatives regardless of expected price or fish catch. In this version the coefficients on price and catch are set to zero.

- A price only version, which assumes only prices, not catch rates, explains the allocation of trips across site/mode alternatives.

- A full model version, which assumes both costs and catch rates explains the allocation of trips across alternatives.

The log of the likelihood function and the estimated parameters for each version of each state model are reported in Table 5.1. On the basis of likelihood ratio tests, the cost only version of the models for each state are a statistically significant improvement over the null model at the 1% level of significance. Similarly, the full model versions are a statistically significant improvement over the cost only versions.

Costs to visit a site and expected fish catch are both significant determinants of where the individual will fish. The price coefficients are all negative and quite consistent across the three states' full model versions. The negative coefficient implies that as the cost of visiting and participating at a particular site/mode alternative increases, ceteris paribus, the probability of visiting that site/mode decreases. The exact change in the probability of visiting the alternative is determined by the partial derivative of the estimated probability equation (4.6) with respect to the cost of visiting that alternative. The coefficients on the catch rates vary

Table 5.1

Multinomial Logit Models
Parameter Estimates

	Coastal Pelagics	Perch	Smelt and Grunion	Flatfish	Bass	Rockfish/ Bottomfish	Salmon	Price	Log of the Likelihood Function
California Null									-83,141
California Price Only								-04.05	-57,516
California Full	.1152	-.1275	.0560	-.0217	-.03312	.0732	.6595	-.0502	-55,699
Oregon Null									-19,506
Oregon Prices Only								-.0550	-14,654
Oregon Full		-.2605	.3621	.6079		.2346	.9770	-.0681	-14,084
Washington Null									-33.905
Washington Prices Only								-.0360	-30,008
Washington Full		-.0702	-.0218	-.3989		.1252	.9888	-.0560	-27,919

* Not all species are included in each full model due to unavailability in the region.

in sign; a positive (negative) coefficient implies that the presence of the species is a positive (negative) attribute of the site. While not calculated, one would expect the multicollinarity among the species to cause the standard errors on the species coefficients to be large. Therefore, a negative coefficient does not necessarily imply that one can reject the null hypothesis that the coefficient has a positive value. However, significant negative coefficients, while possibly surprising, can be explained. The coefficient on perch is consistently negative indicating the presence of perch probably makes it less likely that more desirable species will be present. The negative coefficient doesn't mean that fishermen dislike perch per se.

5.1.2 Per Trip Expected Consumer's Surplus Estimates for the Elimination of Fishing Modes at Individual Sites

The multinomial logit model estimates the probability that an individual will take a trip to each available site/mode alternative under alternative resource price and quality conditions. For example, an individual may have an a priori 30 percent probability of visiting a site/mode alternative. If that alternative is no longer available, the appropriate measure of loss for the individual is not the consumer's surplus associated with a visit to that site, but the expected probability of having visited that alternative times the loss in consumer's surplus if the trip would have been taken to the alternative, but now must be taken elsewhere or forgone. Therefore, the estimates in this and subsequent sections are for changes in consumer's expected net and gross WTP for changes in the characteristics of fishing alternatives. The reported change in expected gross and net WTP for a change in the availability or characteristics of a site/mode alternative apply to all trips taken from the state regardless of whether the trip actually would have been taken to the alternative. The consumer's surplus estimates are, in a sense, per trip option prices for resource preservation.

The economic estimates in this section are also subject to assumptions concerning the value of time discussed in Section 4.4. Sensitivity analysis on the models suggests that a 50 percent change in the assumed average value of time will affect the consumer's surplus estimates by 15 to 25 percent depending upon the site/mode and the individual's origin.

Tables 5.2 through 5.4 report the per trip expected consumer's surplus loss associated with the elimination of shore modes only, boat modes only, and all

Table 5.2

Per Trip Expected CV Associated with Elimination of
Shore Modes (S), Boat Modes (B), and All Modes (A) at each
Destination Site by County of Origin for California (1981)*

County of Origin for 18 Representative Counties (Code)	Destination Site and Mode: San Diego			Orange			City of LA			N. LA County		
	S	B	A	S	B	A	S	B	A	S	B	A
San Diego (37)	8.00	7.39	20.40	1.74	1.85	3.77	1.25	.98	2.30	.73	.54	1.29
Orange (30)	1.19	1.11	2.37	4.08	4.37	9.60	3.20	2.50	6.17	2.03	1.50	3.69
Los Angeles (19)	.41	.38	.80	1.21	1.29	2.58	3.18	2.49	6.14	4.74	3.44	9.22
Ventura (56)	.05	.05	.10	.36	.38	.74	.85	.68	1.56	1.86	1.38	3.37
Santa Barbara (42)	.01	.03	.06	.21	.23	.44	.51	.40	.93	1.10	.82	1.97
San Luis Obispo (40)	0	0	0	.02	.03	.05	.06	.05	.11	.13	.09	.22
Monterey (27)	0	0	0	0	0	0	0	0	0	0	0	.01
Santa Cruz (44)	0	0	0	0	0	0	0	0	0	0	0	0
San Mateo (41)	0	0	0	0	0	0	0	0	0	0	0	0
S.F. (38)	0	0	0	0	0	0	0	0	0	0	0	0
Marin (21)	0	0	0	0	0	0	0	0	0	0	0	0
Sonoma (49)	0	0	0	0	0	0	0	0	0	0	0	0
Mendocino (23)	0	0	0	0	0	0	0	0	0	0	0	0
Humbolt (12)	0	0	0	0	0	0	0	0	0	0	0	0
Del Norte (8)	0	0	0	0	0	0	0	0	0	0	0	0
Sacramento (34)	0	0	0	0	0	0	0	0	0	0	0	0
Napa (28)	0	0	0	0	0	0	0	0	0	0	0	0
Imperial (33)	1.60	1.51	3.25	2.25	2.40	4.95	3.33	2.60	6.45	3.08	2.26	5.75

Table 5.2 (Continued)

County of Origin for 18 Representative Counties	Ventura			Santa Barbara			San Luis Obispo			Monterey		
	S	B	A	S	B	A	S	B	A	S	B	A
San Diego (37)	.08	.08	.17	.04	.06	.10	0	0	0	0	0	0
Orange (30)	.53	.54	1.08	.12	.16	.28	.01	.01	.02	0	0	0
Los Angeles (19)	1.25	1.29	2.63	.64	.90	1.56	.03	.03	.06	0	0	0
Ventura (56)	4.60	4.74	10.78	2.51	3.57	6.62	.27	.22	.50	.01	.0	.01
Santa B. (42)	2.95	3.03	6.51	4.73	6.90	13.99	.54	.44	1.00	.01	0	.03
San Luis Obispo (40)	.76	.79	1.59	1.32	1.85	3.31	9.37	7.29	22.82	.63	.30	.94
Monterey (27)	.02	.02	.04	.03	.05	.08	.60	.48	1.08	8.08	3.52	13.64
Santa Cruz (44)	0	0	.01	.01	.02	.03	.09	.07	.16	2.38	1.12	3.64
San Mateo (41)	0	0	0	0	0	0	.02	.02	.04	.57	.27	.85
S.F. (38)	0	0	0	0	0	0	.01	.01	.03	.36	.17	.54
Marin (21)	0	0	0	0	0	0	.01	.01	.02	.25	.12	.37
Sonoma (49)	0	0	0	0	0	0	.01	0	.02	.09	.05	.14
Mendocino (23)	0	0	0	0	0	0	0	0	0	.04	.02	.07
Humbolt (12)	0	0	0	0	0	0	0	0	0	0	0	0
Del Norte (8)	0	0	0	0	0	0	0	0	0	0	0	0
Sacramento (34)	0	0	0	0	0	0	0	0	.01	.16	.07	.24
Napa (28)	0	0	0	0	0	0	.01	.01	.02	.01	.07	.22
Imperial (33)	.79	.81	1.63	.17	.24	.42	.02	.02	.04	0	0	0

Table 5.2 (Continued)

County of Origin for 18 Representative Counties	Santa Cruz			San Mateo			S.F. Oceanside			Marin		
	S	B	A	S	B	A	S	B	A	S	B	A
San Diego (37)	0	0	0	0	0	0	0	0	0	0	0	0
Orange (30)	0	0	0	0	0	0	0	0	0	0	0	0
Los Angeles (19)	0	0	0	0	0	0	0	0	0	0	0	0
Ventura (56)	0	0	0	0	0	0	0	0	0	0	0	0
Santa B. (42)	0	0	0	0	0	0	0	0	0	0	0	0
San Luis Obispo (40)	.09	.05	.14	.04	.02	.07	.03	.61	.04	.03	.01	.04
Monterey (27)	2.52	1.53	4.27	1.07	.59	1.68	.63	.19	.83	.40	.20	.60
Santa Cruz (44)	4.47	2.66	7.86	2.03	1.10	3.27	1.13	3.29	1.48	.79	.38	1.19
San Mateo (41)	1.14	.70	1.88	3.58	1.90	5.88	2.44	.69	3.24	1.59	.77	2.42
S.F. (38)	.72	.44	1.18	2.11	1.14	3.39	3.67	1.02	4.90	2.51	1.20	3.88
Marin (21)	.50	.31	.81	1.50	.82	2.38	2.86	.81	3.79	3.32	1.57	5.20
Sonoma (49)	.40	.25	.66	1.35	.74	2.14	2.21	.63	2.92	2.17	1.05	3.34
Mendocino (23)	.09	.06	.16	.25	.14	.38	1.09	.32	1.43	1.07	.52	1.62
Humbolt (12)	0	0	0	0	.01	.01	0	.01	.01	0	0	.01
Del Norte (8)	0	0	0	0	0	0	0	0	0	0	0	0
Sacramento (34)	.33	.20	.53	1.40	.76	2.22	2.78	.78	3.69	2.50	1.20	3.87
Napa (28)	.62	.38	1.01	1.25	.68	1.98	2.37	.67	3.14	2.38	1.14	3.67
Imperial (33)	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.2 (Continued)

County of Origin for 18 Representative Counties	Sonoma			Mendocino			Humboldt			Del Norte		
	S	B	A	S	B	A	S	B	A	S	B	A
San Diego (37)	0	0	0	0	0	0	0	0	0	0	0	0
Orange (30)	0	0	0	0	0	0	0	0	0	0	0	0
Los Angeles (19)	0	0	0	0	0	0	0	0	0	0	0	0
Ventura (56)	0	0	0	0	0	0	0	0	0	0	0	0
Santa B. (42)	0	0	0	0	0	0	0	0	0	0	0	0
San Luis Obispo (40)	0	0	0	0	0	0	0	0	0	0	0	0
Monterey (27)	.06	.04	.10	.01	.01	.03	0	0	0	0	0	0
Santa Cruz (44)	.24	.18	.42	.02	.02	.05	0	0	0	0	0	0
San Mateo (41)	.52	.38	.91	.06	.05	.11	0	0	.01	0	0	0
S.F. (38)	.78	.57	1.37	.18	.17	.35	.01	0	.01	0	0	0
Marin (21)	1.24	.92	2.22	.24	.22	.46	.02	.01	.02	0	0	0
Sonoma (49)	3.50	2.54	6.57	.79	.72	1.54	.05	.02	.07	0	0	0
Mendocino (23)	2.09	1.53	3.79	5.61	5.02	12.58	.96	.44	1.42	.07	.05	.12
Humbolt (12)	.03	.02	.06	.50	.45	.96	4.55	5.48	28.33	2.17	1.44	3.79
Del Norte (8)	0	0	0	.04	.04	.09	.73	1.22	4.14	13.01	7.79	32.43
Sacramento (34)	1.31	.97	2.35	.17	.16	.34	.01	0	.02	0	0	0
Napa (28)	1.69	1.24	3.05	.40	.36	.77	.02	.01	.04	0	0	0
Imperial (33)	0	0	0	0	0	0	0	0	0	0	0	0

Table 5.2 (Continued)

County of Origin for 18 Representative Counties	S.F. Bay		
	S	B	A
San Diego (37)	0	0	0
Orange (30)	0	0	0
Los Angeles (19)	0	0	0
Ventura (56)	0	0	0
Santa B. (42)	0	0	0
San Luis Obispo (40)	.08	.04	.12
Monterey (27)	1.26	.64	1.94
Santa Cruz (44)	2.68	1.34	4.23
San Mateo (41)	4.27	2.09	6.90
S.F. (38)	4.00	1.97	6.45
Marin (21)	4.31	2.11	6.96
Sonoma (49)	2.91	1.45	4.60
Mendocino (23)	1.43	.72	2.20
Humbolt (12)	.19	.10	.30
Del Norte (8)	.04	.02	.06
Sacramento (34)	.05	.03	.95
Napa (28)	5.17	2.50	8.48
Imperial (33)	0	0	0

* S = Elimination of Shore Modes at Destination Site.
B = Elimination of Boat Modes at Destination Site.
A = Elimination of All Modes at Destination Site.

Values apply to all trips from an origin prior to mode and site selection. See text.

Table 5.3

Per Trip Expected CV Associated with Elimination of Shore Modes (S), Boat Modes (B), and All Modes (A) at Each Destination Site by County of Origin for the State of Oregon (1981).*

County of Origin for 18 Representative Counties (Code)	Destination Site and Mode											
	Curry			Coos			Douglas			Lane		
	S	B	A	S	B	A	S	B	A	S	B	A
Clatsop (4)	0	0	0	0	0	0	.01	0	.02	.02	0	.03
Coos (6)	.62	.34	.99	5.03	3.57	10.36	2.74	1.23	4.24	1.62	.56	2.25
Curry (8)	9.65	4.58	20.36	1.28	.85	2.34	.65	.30	.96	.39	.14	.54
Douglas (10)	.11	.06	.18	3.41	2.45	6.58	6.18	2.61	10.38	1.23	.43	1.71
Lincoln (21)	.01	0	0	.35	.26	.62	1.07	.48	1.60	2.08	.71	2.91
Lane (20)	.02	.01	.04	1.04	.77	1.87	2.82	1.27	4.37	5.85	1.84	8.70
Tilamook (29)	0	0	0	.02	.01	.04	.25	.12	.37	.47	.17	.65
Washington (34) (Portland Area)	0	0	0	.01	0	.02	.08	.03	.11	.18	.06	.24
Kilamath (18) (S. Central)	1.68	.91	2.70	1.66	1.21	3.04	2.27	1.03	3.49	3.84	1.27	5.51
Deschutes (9) (central)	.09	.05	.14	.88	.65	1.58	2.37	1.07	3.64	4.83	1.56	7.05

Table 5.3 (Continued)

County of Origin for 18 Representative Counties (Code)	Lincoln			Tilamook			Clatsop		
	S	B	A	S	B	A	S	B	A
Clatsop (4)	.32	.13	.46	1.63	.44	2.12	14.60	3.29	26.08
Coos (6)	.36	.15	.52	.01	0	.01	0	0	0
Curry (8)	.02	0	.03	0	0	0	0	0	0
Douglas (10)	.08	.03	.12	.01	0	.01	0	0	0
Lincoln (21)	7.82	2.68	12.74	.91	.25	1.18	.91	.06	.25
Lane (20)	1.85	1.12	2.67	.03	.01	.05	.02	0	.03
Tilamook (29)	1.78	.69	2.56	9.58	2.11	13.96	1.83	.55	2.46
Washington (34) (Portland Area)	1.72	.67	2.48	6.67	1.58	9.25	4.54	1.30	6.35
Kilamath (18) (S. Central)	1.27	.50	1.81	.02	0	.03	.01	0	.02
Deschutes (9) (central)	2.61	1.00	3.82	.39	.11	.51	.26	.08	.35

* S = Elimination of Shore Modes at Destination Site.
B = Elimination of Boat Modes at Destination Site.
A = Eimination of All Modes at Destination Site.

Values apply to all trips from an origin prior to a mode and site selection. See text.

Table 5.4

Per Trip Expected CV Associated with the Elimination of Shore Modes (S), Boat Modes (B), and All Modes (A) at Each Destination Site by County of Origin for Washington (1981).*

County of Origin for 16 Representative Counties (Code)	Pacific			Grays Harbor			Jefferson			Clallam		
	Destination Site and Mode											
	S	B	A	S	B	A	S	B	A	S	B	A
Clark (6)	1.72	6.54	9.08	1.36	3.16	4.80	.05	.07	.12	.02	.06	.08
Cowlitz (8)	1.64	6.21	8.60	1.30	3.02	4.58	.04	.07	.11	.02	.05	.08
Wahkiakum (35)	2.93	12.60	19.15	1.36	3.16	4.79	.05	.07	.12	.02	.06	.08
Pacific (25)	2.57	10.58	15.54	1.64	3.86	5.93	.24	.34	.58	.02	.07	.10
Gray's Harbor (14)	1.09	3.94	3.31	2.73	6.74	10.89	.43	.61	1.07	.18	.52	.71
Jefferson (16)	.02	.07	.09	.18	.40	.58	.19	.26	.46	.24	.70	.96
Clallam (5)	.01	.04	.06	.03	.06	.09	.65	.91	1.61	.81	2.44	3.38
Kitsap (18)	.23	.77	1.01	.49	1.11	1.64	.02	.03	.06	.13	.38	.52
Mason (23)	.51	1.77	2.34	1.14	2.63	3.97	.17	.24	.41	.01	.05	.06
King (17)	.18	.61	.80	.40	.90	1.32	.01	.02	.03	.01	.03	.04
Snohomish (31)	.02	.07	.09	.18	.40	.59	.01	.01	.03	.01	.04	.05
Skagit (29)	.01	.05	.07	.03	.08	.12	.01	.02	.04	.02	.06	.08
Whatcom (37)	.01	.04	.05	.02	.06	.09	.01	.01	.03	.01	.05	.07
Spokane (32)	.10	.35	.46	.23	.51	.75	0	.01	.02	.0	.02	.02
Douglas (9)	.03	.10	.13	.27	.61	.89	.01	.01	.03	0	.02	.03
Walla Walla (36)	.17	.59	.78	.24	.53	.78	.04	.05	.09	0	.01	.01

Table 5.4 (Continued)

County of Origin for 18 Representative Counties	Sekin & Pillar Pt.			East Juan de Fuca St.			San Juan Islands			Deception Pass Hope & Comano Islands		
	S	B	A	S	B	A	S	B	A	S	B	A
Clark (6)	.01	.01	.03	.07	.03	.11	.01	.01	.03	.09	.05	.15
Cowlitz (8)	.01	.01	.03	.07	.03	.10	.01	.01	.03	.34	.16	.50
Wahkiakum (35)	.01	.01	.03	.03	.01	.05	0	0	.01	.03	.01	.05
Pacific (25)	.02	.01	.04	.02	.01	.04	0	0	0	.01	0	.02
Gray's Harbor (14)	.14	.12	.26	.15	.07	.23	0	0	.01	.14	.06	.20
Jefferson (16)	.45	.40	.86	1.96	.97	3.08	.43	.49	.93	1.33	.64	2.02
Clallarn (5)	1.53	1.35	3.02	3.37	1.61	5.34	.16	.18	.35	.50	.24	.75
Kitsap (18)	.22	.19	.42	.96	.48	1.46	.12	.13	.26	.36	.17	.54
Mason (23)	.17	.15	.32	.72	.36	1.10	.09	.10	.19	.33	.16	.49
King (17)	.01	.01	.03	.31	.15	.47	.30	.34	.64	1.88	.88	2.86
Snohomish (31)	.15	.13	.28	.62	.31	.95	.49	.56	1.07	2.81	1.30	4.35
Slagit (29)	.04	.03	.08	.71	.35	1.08	1.75	2.03	4.01	4.01	1.83	6.34
Whatcom (37)	.03	.03	.06	.56	.28	.85	3.27	3.81	7.95	3.26	1.50	5.08
Spokane (32)	0	0	0	.05	.03	.09	.13	.16	.29	.84	.40	1.26
Douglas (9)	.01	.01	.03	.25	.13	.39	.52	.60	1.15	3.06	1.42	4.76
Walla Walla (36)	.03	.02	.06	.13	.06	.19	.08	.09	.17	2.09	.98	3.19

Table 5.4 (Continued)

County of Origin for 18 Representative Counties	Admiralty Inlet			Seattle Bremerton Area			Tacoma Vashon Island			Hood Canal		
	S	B	A	S	B	A	S	B	A	S	B	A
Clark (6)	.12	.06	.19	.14	.10	.25	1.45	.77	2.29	.77	.79	1.60
Cowlitz (8)	.40	.22	.63	.49	.34	.85	1.21	.65	1.90	.64	.66	1.34
Wahkiakum (35)	.04	.02	.06	.04	.03	.08	.44	.24	.68	.24	.24	.48
Pacific (25)	.02	.01	.03	.16	.12	.29	.33	.18	.52	.19	.20	.39
Gray's Harbor (14)	.17	.09	.26	.25	.17	.42	.49	.26	.77	.28	.29	.58
Jefferson (16)	3.53	1.86	5.82	.97	.68	1.70	.49	.25	.71	.74	.75	1.52
Clallarn (5)	1.42	.77	2.26	.39	.27	.66	.31	.16	.48	.49	.50	1.02
Kitsap (18)	1.48	.80	2.36	2.23	1.55	4.00	1.58	.84	2.51	1.11	1.13	2.31
Mason (23)	.81	.44	1.28	1.21	.85	2.12	1.19	.64	1.87	1.40	1.43	2.96
King (17)	2.29	1.22	3.69	2.49	1.73	4.49	1.76	.93	2.80	.43	.44	.88
Snohomish (31)	3.06	1.62	5.00	1.65	1.15	2.92	1.55	.82	2.45	.56	.57	1.16
Slagit (29)	2.23	1.19	3.60	1.21	.85	2.13	.64	.34	.99	.42	.43	.86
Whatcom (37)	1.75	.94	2.80	.96	.67	1.67	.46	.25	.71	.33	.34	.68
Spokane (32)	.99	.54	1.57	4.20	2.88	7.93	4.34	2.23	7.23	.24	.25	.50
Douglas (9)	3.33	1.76	5.48	1.79	1.25	3.18	1.19	.64	1.88	.35	.35	.72
Walla Walla (36)	.59	.32	.93	2.40	1.68	4.34	3.82	1.97	6.30	2.19	2.24	4.45

Table 5.4 (Continued)

County of Origin for 18 Representative Counties	South Puget Sound S	B	A
Clark (6)	1.27	.67	1.99
Cowlitz (8)	1.06	.56	1.66
Wahkiakum (35)	.19	.09	.29
Pacific (25)	.29	.15	.45
Gray's Harbor (14)	.43	.23	.67
Jefferson (16)	.35	.19	.53
Clallarn (5)	.23	.12	.37
Kitsap (18)	1.21	.64	1.89
Mason (23)	1.22	.64	1. 91
King (17)	.77	.41	1.19
Snohomish (31)	.35	.18	.53
Slagit (29)	.26	.14	.40
Whatcom (37)	.20	.11	.31
Spokane (32)	.44	.23	.67
Douglas (9)	.62	.33	.97
Walla Walla (36)	1.60	.84	2.52

* S = Elimination of Shore Modes at Destination Site.
B = Elimination of Boat Modes at Destination Site.
A = Elimination of All Modes at Destination Site.

Values apply to all trips from an origin prior to mode and site selection. See text.

modes at each individual site (generally defined as a county, see Chapter 4) along the pacific coast for trips that are still taken. Expected consumer's surplus decreases for fishermen from counties further away from the site. This reflects that they have a lower probability of visiting the site on any one visit and, by being further away they have higher expenditures and lower consumer's surplus associated with the site. Differences in per trip values in different origin/destination/mode cells reflects differences in the distances and size of the site/mode alternatives and differences in the species available at the site/mode alternatives.

The expected consumer's surplus loss for the elimination of all modes at a site equals or exceeds the sum of the expected loss for the shore modes plus boat modes when individually eliminated. When this difference is large for an individual, it indicates that the two modes at the site are important substitutes for one another. When the difference is small, which is often the case, it suggests individuals are not likely to substitute from one group of modes (shore or boat) at a site to the other group of modes at the site, but rather to substitute to an alternative site.

5.1.3 Aggregate Net and Gross Expected Losses for the Elimination of Modes at All Sites in Each State.

Tables 5.5 and 5.6 report the estimated aggregate expected net and gross loss for the elimination of any one mode or all modes at all sites in the state. The estimates in the first five columns are reported for those trips which originate in the same state as the fishing destination site.

The sixth column is the estimated loss for the elimination of all trips by all modes including those trips originating from out-of-state. Because the model was not estimated incorporating origins from out-of-state, these totals are extrapolations of the average loss per trip for the elimination of all modes based on in-state trips (Tables 5.5 and 5.6 column 5 divided by in-state trips from Table 4.4) times all trips (total trips from Table 4.4). While out-of-state trips are surely associated with higher expenditures and perhaps lower consumer's surplus per trip, the fact that these trips may be multi-day and multi-purpose, and the limited data on these trips, suggests that the relative accuracy of this, or other more complicated extrapolations will be difficult to assess.

Table 5.5

The Aggregate Net Value of Marine Recreational Fishing in 1981 by Mode and in Total*

($1,000 1981)

SITE	TRIPS ORIGINATING IN THE SAME STATE AS SITE					ALL TRIPS
	Beach and Bank	Man-made	Partyboat	Private Boat	All Modes	All Modes**
California	$72,664	$56,986	$25,373	$69,708	$661,542	$690,253
Oregon	6,113	6,459	788	3,503	50,421	59,351
Washington	10,822	8,502	3,095	13,120	76,797	90,177
TOTAL	$89,598	$71,947	$29,256	$86,330	$788,760	$839,781

* Totals are the aggregate of individual trip values for all trips originating in the state. Individual mode totals are based upon the elimination of the mode at all sites in the state. "All mode" totals are based upon the elimination of all mode/site combinations with a probability of being visited greater than or equal to one percent, defined uniquely for each county of origin.

** All Trips All Modes values (last column) calculated from in-state values for all modes and multiplied by the ratio of total trips to destination state divided by in-state trips (Table 4.4). See text for additional discussion.

Table 5.6

The Aggregate Gross Value of Marine Recreational Fishing in 1981 by Mode and in Total*

($1,000 1981)

SITE	TRIPS ORIGINATING IN THE SAME STATE AS SITE					ALL TRIPS
	Beach and Bank	Man-made	Partyboat	Private Boat	All Modes	All Modes**
California	$147,522	$118,881	$193,441	$186,317	$952,561	$ 993,900
Oregon	19,172	19,937	5,308	15,773	91,182	107,332
Washington	22,410	18,045	15,652	35,763	123,924	145,515
TOTAL	$189,105	$156,863	$214,401	$237,854	$1,167,667	$1,246,747

* Totals are the aggregate of individual trip values for all trips originating in the state. Individual mode totals are based upon the elimination of the mode at all sites in the state. "All mode" totals are based upon the elimination of all mode/site combinations with a probability of being visited greater than or equal to one percent, defined uniquely for each county of origin.

** All Trips All Modes values (last column) calculated from in-state values for all modes and multiplied by the ratio of total trips to destination state divided by in-state trips (Table 4.4). See text for additional discussion.

The aggregate estimates for the elimination of individual modes may overstate aggregate net economic losses. This is because the multinomial logit model used assumes the existing level of trips will continue to be taken, where as some individuals will experience smaller consumer's surplus losses by substituting out of fishing rather than substituting to an alternative site/mode alternative. Similarly, the model understates net economic gains from the addition of new site/mode alternatives as new individuals may choose to participate given the availability of new alternatives, or existing participants may choose to take more trips. Future work should account for this effect by linking multi-site participation models to the multinomial logit economic model.

The aggregate estimates of economic losses for the elimination of a mode will overstate actual gross losses because individuals may substitute to alternative activities at a reduced loss rather than substitute to an alternative site/mode combination.

Estimating gross and net WTP for the existence, versus non-existence, of marine recreational fishing is complicated with the multinomial logit model because substitution to non-fishing activities is not modeled with the multinomial logit approach. The multinomial logit approach measures changes in welfare for those trips that continue to be taken. The values for the elimination of all fishing opportunities were proxied by measuring the change in net and gross WTP for existing trips if all site/ mode alternatives were eliminated which the individual had an X percent or greater chance of visiting. Alternative values for X (10%, 5%, 1%, .5%, .1%) were tried to examine the sensitivity of this selection. As X decreased, the economic measure of loss increased because the individual is forced to select among sites that are increasingly less desirable and further away. If X is too large, the estimates will understate true losses as only the most favorite sites will be lost, yet many fishermen will continue to fish at alternative site/modes rather than cease to participate. If X is too small, the estimates will overstate true losses as most fishermen will cease to participate rather than travel to far away undesirable sites at very high costs.

A one percent level for X was selected as the level upon which to base the estimates presented in the tables. At X levels higher than one percent the implied losses for the eliminations of all mode/site alternatives with a probability of being visited of x percent or more did not consistently exceed the sum of the losses for the individual modes, as is be required for consistency. The one percent level was also selected based upon results from the individual data single equation model results (See Section 5.2). That analysis suggested that site visits would decrease by 50 percent if travel distance increased by 200 miles or more. Given closer alternatives, the current probability of visiting site/mode alternatives 200 miles further away than the closest sites for most participants is extremely small. In fact, the data suggests it is much less than 1 percent. While the single equation models in Section 5.2 are rudimentary, they do suggest that significant increases in travel distances must occur to result in significant decreases in total trips taken by active participants.

5.1.4 Estimated Net WTP Per Trip for the Change In Expected Fish Catch

Changes in expected net WTP per trip were estimated for increases in expected catch by one fish at all sites where that fish is generally caught. The estimates are presented for selected species and counties of origin in Tables 5.7 through 5.9. It should be noted these are not per fish values, but marginal increases in value per trip for increases in expected catch by one fish and apply to all trips prior to site/mode selection. For species where less than one fish is typically caught per trip, such as Salmon, the per trip values are higher.

Estimates for some fish are negative, which is attributed to multicollinearity in the analyses and that often when and where some fish are caught, others are not caught. It should not necessarily be inferred that values for incremental catch of these species are negative. Species where the model generally

Table 5.7

Per Trip Expected CV Associated with Increasing Selected Species Catch Rate by One Fish Per Trip at All Site/Modes Where the Species is Caught ($):

1981 California*

County of origin for 18 repres. counties	Salmon	Coastal Pelagics	Smelt	Rockfish/ Bottomfish	Perch
San Diego	0.0	2.16	.89	1.44	-2.21
Orange	.01	1.98	.75	-1.41	-2.15
Los Angeles	.02	2.03	.73	1.35	-2.18
Ventura	.13	2.09	.89	2.41	-2.21
Santa Barbara	.26	2.04	.94	1.43	-2.21
San Luis Obispo	3.57	1.89	.92	1.45	-1.63
Monterey	5.65	1.07	.69	1.42	-2.05
Santa Cruz	5.50	.08	.65	1.30	-1.87
San Mateo	6.15	.13	.64	1.32	-1.82
San Francisco	6.05	.13	.61	-1.32	-1.82
Marin	5.46	.06	.58	1.30	-1.81
Sonoma	6.07	.03	.44	1.33	-1.68
Mendocino	8.06	.01	.42	1.39	-1.54
Humbolt	9.99	0.0	.88	1.37	-2.13
Del Norte	7.29	0.0	.48	1.43	-1.64
Imperial	0.0	2.20	.93	1.44	-2.22
Napa	5.64	.05	.57	1.32	-1.83
Sacramento	5.42	.04	.62	1.30	-1.83

* In 1981 dollars. Expected values apply to all trips from the county or origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP).

Table 5.8

Per-Trip Expected CV Associated with Increasing Selected Species Catch Rate by One Fish Per Trip at All Site/Modes Where the Species is Caught ($):

1981 Oregon*

County of origin for 10 repres. counties	Salmon	Smelt	Flatfish	Rockfish/ Bottomfish	Perch
	SPECIES				
Curry	13.97	2.05	1.69	3.36	-2.47
Coos	12.80	3.54	5.60	3.30	-2.83
Douglas	12.45	3.66	6.03	3.30	-2.72
Lane	10.27	2.32	5.93	3.04	-2.83
Lincoln	12.47	2.99	7.09	3.29	-3.25
Tilamook	10.56	.71	5.32	3.14	-3.30
Clatsop	9.99	.15	6.69	2.81	-2.95
Washington (Portland)	10.75	.73	5.36	3.17	-3.33
Klamath (South Central)	11.54	2.47	5.10	3.15	-2.76
Deschutes (Central)	10.70	2.35	6.07	3.09	-2.91

* In 1981 dollars. Expected values apply to all trips from the county of origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP).

Table 5.9

Per Trip Expected CV Associated with Increasing Selected Species Catch Rate by One Fish Per Trip at All Site/Modes Where the Species is Caught ($):

1981 Washington*

County of origin for 16 repres. counties	SPECIES Salmon	Rockfish/ Bottomfish	Perch
Clark	12.88	2.20	-.96
Cowlitz	13.05	2.21	-.96
Wahkiakum	14.18	2.21	-.87
Pacific	14.08	2.17	-.87
Grays Harbor	13.55	2.09	-.94
Jefferson	12.84	1.99	-.72
Clallam	11.97	1.61	-.43
Kitsap	11.33	2.11	-.94
Mason	11.92	2.11	-.96
King	12.59	2.20	-.98
Snohomish	13.31	2.17	-.89
Skagit	14.80	2.18	-.81
Whatcom	15.46	2.19	-.78
Spokane	10.77	2.24	-1.10
Douglas	13.66	2.21	-.92

* In 1981 dollars. Expected values apply to all trips from the county of origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP).

estimated negative values were: Perch, Flatfish and Bass in California; Perch in Oregon; and Smelt, Flatfish, Perch and Bass in Washington. The Salmon numbers may also have unique problems, as discussed in the next section.

5.1.5 Estimating Net WTP Per Trip for the Elimination of Salmon Fishing

Changes in expected net WTP per trip were estimated for the elimination of all Salmon fishing in each state by setting the expected catch of the species to zero. The estimates are presented for selected counties in Tables 5.10 through 5.12. Values for Salmon fishing in Oregon and Washington exceed those in California due both to higher expected catch and because Salmon fishing is available at more alternatives sites in Oregon and Washington.

There is an important caveat for the use of these estimates. One one hand, the estimates are subject to upward biases by not considering substitutions out of fishing resulting in somewhat lower average net WTP losses. On the other hand, the MRFSS intercept survey procedure of generally not sampling Salmon fishermen will bias the estimates downward. The numbers are best used in cross-site comparisons.

5.1.6 Comparisons of 1981 and 1980 Per Trip Net WTP Values

A Southern California only model was estimated separately for 1980 and 1981 to check the stability of the basic model over time. The parameter estimates are reported in Table 5.13. The two price coefficients are very similar, but the catch rate coefficients vary substantially between the two periods. This is as expected, since relative costs did not change much from 1980 to 1981, but catch rates changed appreciably (see Section 4.4).

Table 5-10

Per Trip Expected CV Associated With the Elimination of Salmon Fishing Opportunities in California (1981) by County of Residence

County of Origin for 18 Representative Counties	CV/Trip
San Diego	0.0
Orange	0.0
Los Angeles	0.0
Ventura	.01
Santa Barbara	.03
San Luis Obispo	.43
Monterey	1.15
Santa Cruz	1.54
San Mateo	1.97
San Francisco	1.87
Marin	2.05
Sonoma	2.34
Mendocino	2.61
Humboldt	2.89
Del Norte	2.77
Sacramento	2.08
Napa	2.14
Imperial	0.0
58 County Average (unweighted)	1.62

* In 1981 dollars. Expected values apply to all trips from the county of origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP).

Table 5.11

The Per Trip Expected Consumer Surplus Associated with the Elimination of Salmon Fishing Opporutnities in Oregon (1981) by County of Residence

County of Residence for 10 Representative Counties	CV/Trip
Curry	4.03
Coos	5.85
Douglas	5.66
Lane	5.70
Lincoln	5.05
Tilamook	2.50
Clatsop	2.45
Washington	2.50
Klamath	5.36
Deschutes	5.42
36 County Average for Oregon (unweighted)	3.99

* In 1981 dollars. Expected values apply to all trips from the county of origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP)

Table 5.12

The Per Trip Expected Consumer Surplus Associated with the Elimination of Salmon Fishing Opportunities in Washington (1981) by County of Residence

County of Residence (origin) for 16 Representative Counties	CV/Trip
Clark	5.61
Cowlitz	5.38
Wahkiakum	7.27
Pacific	7.03
Grays Harbor	6.19
Jefferson	2.25
Clallan	3.12
Kitsap	2.79
Mason	3.61
King	2.25
Snohomish	1.76
Skagit	1.77
Whatcom	1.90
Spokane	1.94
Douglas	1.85
Walla Walla	2.22
39 County Average (unweighted)	2.96

* In 1981 Dollars. Expected values apply to all trips from the county of origin.

CV = Compensating Variation Measure of Consumer's Surplus (Net WTP).

Table 5.13

Multinomial Logit Model Parameter Estimates for the Southern California Model in 1980 and 1981

	Variable and Coefficient						
Model	Bonito	Perch	Smelt	Halibut	Bass	Rockfish/ Bottomfish	Price
Southern California 1980	-.0125	-.2735	.5241	.0934	-.0106	-.0298	-.0688
Southern California 1981	.1798	-.4770	4.146	-.6885	.1025	.0826	-.0651

Tables 5.14 and 5.15 report the expected net and gross willingness to pay measures for fishing in Southern California by county of origin. The average all mode 1980 and 1981 net WTP magnitudes are, for the most part, very similar, suggesting that the 1981 per trip WTP measures for California, Oregon and Washington can be used (suitably inflated) to estimate benefits in other years.

5.2 SINGLE EQUATION TRAVEL COST MODEL ANALYSIS WITH THE MRFSS S/E DATA

This section presents preliminary analyses using the MRFSS S/E survey data for Southern California (San Diego, Orange, Los Angeles, Ventura, Santa Barbara, and San Luis Obispo counties). The travel cost models presented are of the single equation variety and use micro-data, or observations on individual participants, as discussed in Section 4.3. The MRFSS S/E survey data was also processed for the entire Pacific Coast to provide estimated trip expenditures by mode for each state. For additional analysis and discussion of the MRFSS S/E data, see Heitt, et al. (1983).

Socioeconomic and Trip Data

Table 5.16 presents background socioeconomic and trip taking data for Southern California MRFSS S/E respondents. While 321 participants were in the survey, many failed to follow through on the S/E component (only 65 to 75 percent, depending upon mode). This leads to such inconsistencies as the average number of days at the intercept site in the last year (from the intercept survey) exceeding total days fishing (from the telephone follow-up) for those fishing from man-made structures. Many individuals did not answer groups of questions on the survey. The effective sample size for statistical analysis is, therefore, generally 200 or less, rather than 321. Moreover, many variables were coded as zero, rather than missing, when missing may have been appropriate. For example, over 40 percent of partyboat participants had, or reported, $0.0 in expenses. These figures are therefore adjusted to reflect average costs for those incurring and reporting costs.

Table 5.14

Comparison of Expected Per Trip Net Values (Consumer's Surplus) for the Elimination of Individual Modes and all Modes in Southern California in 1980 and 1981*

County of Origin in Southern California	Mode 1 Beach and Bank	 2 Man-made	 3 Partyboat	 4 Private Boat	 Total All Modes **
San Diego 1980	7.73	5.02	1.57	5.07	54.73
San Diego 1981	10.28	4.64	1.89	2.30	51.12
Orange 1980	7.45	4.45	1.74	5.32	51.44
Orange 1981	5.19	5.62	2.72	4.30	47.51
Los Angeles 1980	8.68	4.31	1.53	4.69	54.95
Los Angeles 1981	6.61	5.65	2.74	3.03	56.38
Ventura 1980	7.38	4.42	1.74	5.43	42.01
Ventura 1981	7.80	3.54	3.40	3.37	49.11
Santa Barbara 1980	7.40	4.46	1.69	5.41	48.34
Santa Barbara 1981	6.73	4.09	3.93	3.16	47.67
San Luis Obispo 1980	8.16	3.47	1.75	5.32	59.69
San Luis Obispo 1981	7.76	1.74	3.34	5.49	66.47

* Both figures are in 1981 dollars. Expected values apply to all trips from the origin county.

** Values derived for the elimination of all mode/site combinations with a probability of being visited greater than or equal to one percent, defined separately for each county of origin. See text for discussion.

Table 5.15

Comparison of Expected Per Trip Gross Values (Consumer's Surplus plus Expenditures) for the Elimination of Individual Modes and All Modes in Southern California in 1980 and 1981*

County of Origin in Southern California	Mode 1 Beach and Bank	Mode 2 Man-made	Mode 3 Partyboat	Mode 4 Private Boat	Total All Modes **
San Diego 1980	13.24	9.15	5.73	13.28	74.88
San Diego 1981	16.35	9.31	7.15	7.26	70.02
Orange 1980	14.85	9.18	6.43	14.44	74.76
Orange 1981	12.05	11.15	10.09	11.34	71.27
Los Angeles 1980	15.42	8.62	5.80	13.07	76.52
Los Angeles 1981	13.44	11.08	10.59	9.35	81.45
Ventura 1980	14.24	8.72	6.28	14.26	67.31
Ventura 1981	12.52	7.18	11.59	8.82	68.37
Santa Barbara 1980	13.65	8.43	6.12	14.04	68.43
Santa Barbara 1981	12.49	7.62	13.22	8.97	68.98
San Luis Obispo 1980	14.25	7.59	6.28	13.95	80.56
San Luis Obispo 1981	13.74	4.21	12.05	13.83	90.97

* All figures in 1981 dollars. Expected values apply to all trips from the origin county.

** Values derived for the elimination of all mode/site combinations with a probability of being visited greater than or equal to one percent, defined seperately for each county of origin. See text for discussion.

Table 5.16

Means, Number of Observations and Ranges of Travel Cost Variables in the MRFSS S/E Survey for Southern California by Mode*

Means (for those answering)	Mode 1 Man Made Structure	Mode 2 Beach/Bank	Mode 3 Party/Charter Boat	Mode 4 Private/Rental	Total
Max No. of Observations	99	68	67	87	321
No. Days at Intercept Site Last 12 Months	36 (92) 1-365	21 (60) 1-225	5.7 (64) 1-48	19.0**(3) 1-500	21.8 (305) 1-500
Total No. of Days Fishing Last 12 Months	35 (64) 1-250	36 (44) 1-365	36.6 (44) 0-280	28.5 (66) 1-200	33.8 (218) 1-365
Distance From Here	38 (99) 1-400	47.18 (67) 0-400	45.23 (65) 1-250	38.06 (86) 1-850	41.44 (317) 1-850
Distance from Where Stayed Last Night of not at Home	6 (15) 1-30	4.67 (12) 0-35	16.14 (7) 1-40	12.17 (6) 0-40	8.30 (40) 0-40
Distance Traveled to Site from Where Stayed Last Night	11.6 (95) 0-50	12.87 (62) 0-50	14.49 (67) 0-40	13.49 (77) 0-60	12.99 (301) 0-60
Total Variable Expenditures for Intercept Trip (Includes Travel Costs)	17.02 (65) 0-228.00	36.48 (44) 0-222.00	42.09 (44) 0-125	29.55 (66) 0-119	29.74 (219) 0-228
Total Equipment Expenditures (Excludes Boats and Motors)	314.52 (65) 0-5000.00	363.52 (44) 0-3000.00	728.36 (44) 0-5000	789.96 (66) 0-5000	550.79 (219) 0-5000
Total No. of Fish Caught	3.9 (99) 0-101	2.2 (68) 0-13	7.9 (67) 0-41	8.3 (87) 0-60	5.6 (321) 0-101

* Table cells report mean values, (number of observations), and range of observed values.

** If the outlier value of 500 is dropped, the mean falls to 13.1. If it is changed to a maximum of 365, the mean falls to 17.4.

Table 5.16 shows that anglers fishing from shore modes tend to fish from the site they were intercepted at more often than anglers fishing from boats, especially partyboats. Across all modes the average total number of days fishing in the last year is quite similar. It should be noted that the number of days fished at the intercept site for private/rental boat modes is biased upwards by an outlier value of 500 days. If this value is dropped, mean days from this mode would be 13.1 over 82 observations. If this value is given the maximum possible of 365, then mean days drop to 17.4 days over 83 observations.

Average variable expenditures for a day's fishing, including travel expenses, varies somewhat across modes, from a low of $17 for fishing from man-made structures to a high of $42 for charter/party boat fishing. People who fish from boats own fishing equipment, excluding boats and motors, valued at twice that of shore anglers. Boat anglers on average catch at least twice as many fish per day as shore anglers.

Examining relative frequencies along with means gives a better insight into the data set. Three distance variables in Table 5.16 highlight this point. Average distance from home across all modes is 41 miles but the ranges vary considerably, from a maximum of 250 miles for party/charter boat anglers to 400 miles for shore fishing and 850 miles for private/rental boat fishing. The average distance traveled to the intercept site from the previous night's lodging is much less. Approximately 12.5 percent of all anglers interviewed did not stay at home the night before the intercept interview. Rather, they had stayed within 40 miles of the site. The average distance traveled from where they stayed last night, which equals either distance from home or from where they stayed last night if not at home, is only 13 miles with a maximum of 60 miles across all sites. Thus, it can be determined that 87.5 percent of those intercepted live within 60 miles of the site and it seems reasonable to assume that most fishing trips were likely to be single purpose trips primarily for fishing.

Table 5.17 presents relative frequencies of responses for selected variables. Close to 30 percent of those interviewed spent only one day fishing at the intercept site in the previous 12 months, while over 50 percent fished at that site for five or fewer days. This compared with a mean of 22 days for the season. It should be noted, however, that the sites are quite narrowly defined. Thus, another fishing location only five miles away, although quite similar, would be considered a separate site in the survey. Since these individual sites will be grouped into larger sites for further travel cost analysis, the observed number of trips to the intercept site will tend to understate the actual number of trips to the grouped site.

Close to half of all anglers intercepted expressed a preference for catching a particular species. A larger percentage of anglers fishing from boats expressed preferences than those fishing from shore. Fishing from boats is more successful than fishing from the shore. Eighty percent of those fishing from boats caught some fish compared to only 50 percent for those fishing from shore. Boat anglers also catch a greater variety of fish per day. Of those anglers who caught fish, at least 60 percent of those fishing from shore caught only one species of fish while 67 percent of boat anglers caught more than one species of fish.

Travel Cost Models

The MRFSS S/E survey data cannot be partitioned by mode or destination site due to the small sample size of only 218 useable observations. However, the variation in price and fish catch across modes and sites does allow the estimation of the influence of these variables in the demand for site visits using the single equation model. The model discussed in Section 4.3.1 was estimated with a linear and a semi-log functional form. The results are reported in Table 5.18

There is a high degree of comparability and stability across the two estimated equations reported in Table 5.18, as well as other estimated but unreported variations of these equations. The own price elasticity of demand, estimated at the mean, ranged between .20 and .40 in all specifications (it is .27 and

Table 5.17
Selected Frquencies of MRFSS S/E Southern California*
Trip Data by Mode (Percent)

	Man-Made Structures	Beach/Bank	Party/Charter Boat	Prive/Rental Boat	Total
Number of Days at Intercept Site Last 12 Months					
1 day only	26.1	28.8	45.3	21.7	29.5
1-5 days	48.9	45.5	75.0	45.8	52.8
Total Number of Days Fishing Last 12 Months					
1 day only	7.8	2.3	8.2	1.5	6.9
1-5 days	29.7	25.0	38.6	16.7	28.0
Were you Fishing for a Particular Species					
Yes	33.3	42.6	53.7	60.9	47.0
No	66.7	57.4	46.3	39.1	53.0
Did you Catch any Fish Today?					
Yes	52.5	50.0	80.6	80.5	65.4
No	47.5	50.0	19.4	19.5	34.6
Number of Species Caught (Percent of Those Catching Fish)					
1 Fish	73.1	60.6	20.4	32.9	44.0
2 Fish	17.3	24.2	35.2	28.6	26.8
3 Fish	3.8	15.2	11.1	22.9	13.9
Types of Transportation to the Site					
Private Vehicle	94.9	97.1	98.5	100.00	97.5

* Percents presented for various questions do not total to 100 due to omitted answer categories.

Table 5.18

Single Equation Travel Cost Model Results For Southern California with Individual Data From the MRFSS S/E Survey

A. Model Results (t-statistics in parenthesis)

Linear Model

$$Y_{jmi} = \underset{(1.4)}{-17.0} - \underset{(-2.44)^{***}}{.213\, p_{jmi}} + \underset{(4.64)^{***}}{.261\, D_i} + \underset{(2.21)^{**}}{.347\, Age}$$

$$+\underset{(.94)}{2.56\, a_{jm1}} + \underset{(1.80)^{*}}{17.2\, a_{jm2}} + \underset{(3.05)^{***}}{95.6\, a_{jm3}} + \underset{(1.64)^{*}}{26.3\, a_{jm4}}$$

$$+\underset{(.20)}{.755\, a_{jm5}} + \underset{(.61)}{.732\, a_{jm6}}$$

NOBS = 193 , R^2 = .136 F = 6.11***

Semi-Log Model

$$\ell n\,(Y_{jmi}) = \underset{(1.62)}{.638} - \underset{(4.98)^{***}}{.014\, P_{jmi}} + \underset{(4.56)^{***}}{.00825\, D_i} + \underset{(3.11)^{***}}{.0158\, Age}$$

$$\underset{(.17)}{-.0155\, a_{jm1}} + \underset{(1.66)^{*}}{.512\, a_{jm2}} + \underset{(2.11)^{**}}{2.14\, a_{jm3}} + \underset{(3.15)^{***}}{1.64\, a_{jm4}}$$

$$+ \underset{(.67)}{.0840\, a_{jm5}} + \underset{(.09)}{.0035\, a_{jm6}}$$

NOBS = 193 R^2 = .202 F = 9.22***

Variables

Y_{jmi} = # trips to site j by individual i fishing by mode m.
P_{jmi} = price for a one day visit to site j, mode m for individual i.
D_i = total # days invididual i fished during the year
Age = individual i's age
a_{jmk} = expected catch for site j mode m species k. k values are: 1 = Coastal Pelagics, 2 = Perch, 3 = Smelt & Grunion, 4 = Flatfish, 5 = Bass, 6 = Rockfish & Bottomfish.

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* Significant at the 5% one-tailed test level or 10% two tailed test level.

** Significant at the 2.5% one-tailed test level or 5% two-tailed test level.

*** Significant at the 1% one-tailed test level or 2% two-tailed test level.

.37 for the reported linear and semi-log specifications). These results, combined with the average income and travel costs per mile, imply that individuals would have to travel about 200 additional miles to reduce average site visits by 50 percent and over 300 additional miles to reduce average site visits by 75 percent. However, The model was estimated with very few observations from distances in excess of 100 miles and may be considered unreliable for such extrapolations.

Socioeconomic variables were seldom significant in these specifications, except for age, experience and the value of equipment, which were highly correlated.

The effects of incremental fish catch were found to be quite consistent across model specifications. In general, increases in Perch, Smelt, and Flatfish increased trip taking and were statistically significant. This is in contrast to the results of the multinomial logit model results where Perch was found to have a negative effect on trips. Again, multicollinearity may be the underlying problem in this inconsistency. The statistical significance of overall inclusion, versus exclusion, of the catch variables in the single equation travel cost models was tested by running the regressions with and without these variables. The F-test for the inclusion of the catch variables as a group was significant in all specifications at the one percent level. No other statistical tests or corrections, such as heteroskedasticity adjustments, were conducted.

Before calculating consumer's surplus estimates with these functions, it is important to reiterate several critical limitations in the model. First, the model does not account for mode and site substitutions, which upwardly bias the consumer's surplus estimates. For a system of sites, the demand equation is not consistent with a budget constraint. If one uses these equations to predict total number of predicted fishing days across all sites and modes (D_i^*), D_i^* will likely exceed D_i for most individuals in the sample. For example, for many individuals with D_i=1, D_i^* exceeds 20. Further, because Di does not change with changes in Y_{jmi}, the model implicitly assumes total trips are constant so and changes in Y_{jmi} occur through mode or site substitution. Each of these effects upwardly biases the consumer's surplus estimates.

Consumer's Surplus Estimates with the Single Equation Models

Per trip consumer's surplus estimates for the elimination of site i mode m, using the linear specifications, will vary depending upon the individual's P_{jmi} and D_i. Table 5.19 presents per trip consumer's surplus for the elimination of site/mode alternatives for three representative individuals. Each individual is assumed to face mean on-site prices and travel costs and be the mean age. The difference across individuals is in total fishing trips per year (D_i), assumed to be 1, 6 and 24. The per trip consumer's surplus estimates vary dramatically and increase with the number of trips taken per year.

The per trip consumer's surplus estimate with the semi-log specification is, as outlined in Section 4.3, constant for all individuals and, for the reported equation equals $71 per trip.

These single equation model consumer's surplus figures for the elimination of a site/mode alternative greatly exceed those estimated with the multinomial logit model for the elimination of a site/mode. Among the reasons for the difference is:

1. The two travel cost methods are not measuring the same thing. The multinomial logit model (MLM) provides an estimate of WTP to have an option of visiting the site/mode even if it is not actually visited, whereas the single equation model (SEM) measures the average consumer's surplus associated with a visit. The MLM is an expected value, while the SEM is a deterministic value.

2. The MLM explicity accounts for substitution across site/mode alternatives, keeping budget constraints intact. The SEM does not account for substitutions in the consumer's surplus estimates, even through such substitutions are implicitly required in the model.

Table 5.19
Per Trip Consumer's Surplus Associated with the Elimination of Site J Mode M for Three Representative Individuals using the Linear Single Equation Model*
($ 1981)

	Individual 1[a]	Individual 2[b]	Individual 3[c]
San Diego County			
Man Made Structure	25.38	39.62	53.10
Beach/Bank	11.78	2.35	68.03
Partyboat	2.35	7.86	21.34
Private Boat	10.66	24.93	38.40
Southern Orange County			
MM	23.03	37.28	50.75
BB	12.32	26.60	40.07
PB	2.35	2.35	15.75
PR	2.35	15.99	29.46
Los Angeles City			
MM	60.23	74.53	87.96
BB	26.88	41.15	54.62
PB	2.35	6.50	19.98
PR	10.94	25.21	38.69
Northern Los Angeles County			
MM	52.93	67.18	80.66
BB	13.31	27.58	41.06
PB	17.72	32.00	45.47
PR	43.59	57.91	71.38
Ventura County			
MM	71.34	85.59	99.06
BB	7.89	22.16	35.63
PB	2.35	27.32	18.66
PR	20.05	34.55	48.03
Santa Barbara County			
MM	27.86	42.11	55.59
BB	62.49	77.07	90.23
PB	2.35	7.30	20.77
PR	35.31	49.58	63.05

Table 5.19 (Continued)

	Individual 1[a]	Individual 2[b]	Individual 3[c]
San Luis Obispo County			
MM	41.41	56.36	69.13
BB	44.15	57.72	71.90
PB	2.35	3.83	17.30
PR	5.96	20.23	22.71

* Representative individuals facing mean prices and travel distance, with mean age and income.

[a]Represents an individual with only 1 total fishing day/year.
[b]Represents an individual with 6 total fishing days/year.
[c]Represents an individual with 24 total fishing days/year.

6.0 DESIGN AND PRETEST OF A TRAVEL COST/CONTINGENT VALUATION SURVEY INSTRUMENT FOR THE SAN FRANCISCO AREA

6.1 OBJECTIVES

The overall objective of this effort was to redesign a survey instrument to measure economic values of marine recreational fishing in the San Francisco Bay and Ocean Area (SFBOA). The effort was undertaken recognizing the limitations of existing survey instruments to measure these economic values, as discussed in Chapter 3, and with the intent of formulating a new more usuable instrument for economic analysis. The SFBOA was selected primarily due to the heavy demand for Salmon and Striped Bass fishing in the area, which is not captured by other NMFS survey instruments. The instrument is to be designed so that, with other available data, one can:

- Estimate per trip and aggregate Willingness-to-Pay (WTP) for all fishing trips to this area for Salmon, Striped Bass, Rockfish and Bottomfish. Sufficient data should be available to make these estimates with the best available travel cost models in a manner consistent with economic theory. Both gross (total) and net (consumer surplus) WTP estimates are to be able to be made with the data.

- Estimate WTP for incremental fish availability (using expected catch) for these same four species. This may involve the use of contingent valuation methods.

- Estimate the consumer's surplus portion of WTP for different trip characteristics.

- Examine contingent valuation methods (CVM) as alternatives to travel cost methods.

The survey instruments formally pretested are found in Appendix B.

6.2 DESIGN CONSIDERATION

6.2.1 Characteristics of the Survey Area

The survey area is defined as all of San Francisco, San Pablo and Suisun Bay waters, and ocean waters from Half Moon Bay on the south to Bodega Bay on the north. (See Figure 6.1. A detailed description of the area can be found in Squire and Smith, 1977). The primary species sought in these waters include Striped Bass and Sturgeon in the ocean and bay waters, Salmon primarily in the ocean just outside of the Golden Gate Bridge (the Gulf of Farallones) and Ling Cod, Surfperch, Rockfish, Bottomfish and other species in the ocean. The primary fishing seasons for Striped Bass and Salmon are from spring through November with the peak season in the late summer and fall. The seasons vary depending upon location (see Squire and Smith, 1977 for further details).

Partyboat fleets are primarily found in Half Moon Bay and at the San Francisco Piers. Private boat piers occur throughout the area. Shore fishing on the ocean occurs primarily at Half Moon Bay state beaches, Pacifica, Thorton State Beach, West San Francisco, Pt. Bonita, Stinson's Beach, Drakes Beach, Point Reyes Beach and in Bodega Bay. Shore fishing in the bays occur at Berkeley, Burlingame and San Mateo, Bakers Beach in San Francisco, in the north bay from Sausalito to San Quentin Point, and at the Napa River and Sluice.

The design of the survey instrument must reflect the characteristics of the experience being studied. Characteristics of the marine recreational fishing experience in the San Francisco Bay and Ocean Area, using data from the 1981 MRFSS intercept survey, are presented in Table 6.1. It should be repeated that the MRFSS intercept survey was designed to generally not include trips where Salmon and Striped Bass were being targeted. Therefore, those statistics provide a potentially biased view of all marine recreational fishing trips in the SFBOA.

Figure 6.1
San Francisco Bay and Ocean Area

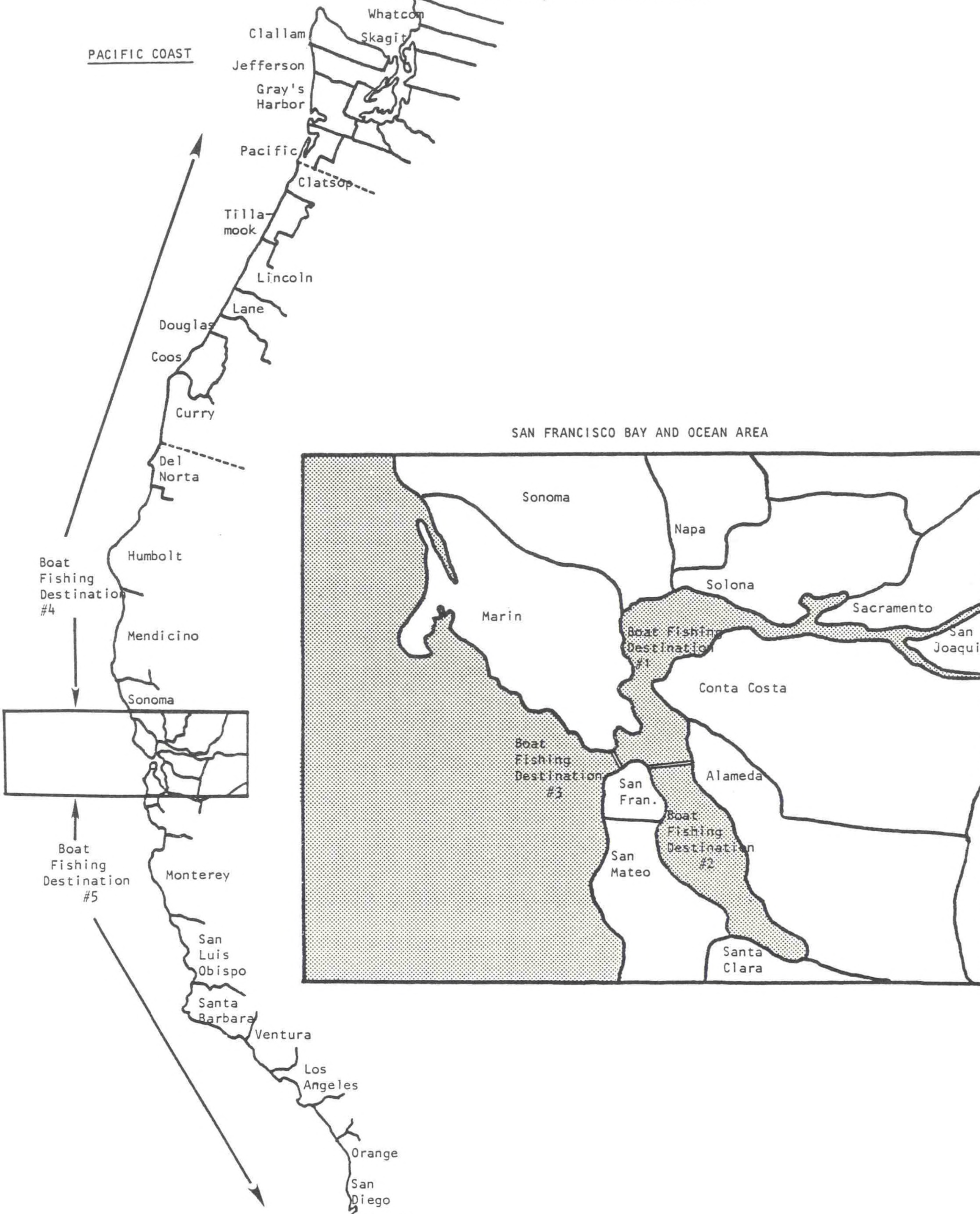

Table 6.1

Characteristics of the Fishing Experience in the San Francisco Bay and Ocean Area[1]

A. Distribution of fishermen trips by origin (distance from site).

	Site: Ocean2	Site: Bay
Private/Rental Boats		
up to 50 miles	44-68%	89%
100 miles	53-78%	97%
150 miles	78-100%	99%
200 miles	100%	100%
Partyboats		
up to 50 miles	24-79%	68%
100 miles	30-98%	88%
150 miles	81-100%	88%
200 miles	100%	92%
Beach & Bank		
up to 50 mile	68-99%	96%
100 miles	74-100%	98%
150 miles	99-100%	99%
200 miles	100%	100%
Man-made Structures		
up to 50 miles	63-82%	96%
100 miles	75-97%	99%
150 miles	100%	100%
200 miles	100%	100%

B. Percent fishermen trips on which any fish is caught.

	Ocean2	Bay
Private/Rental Boats	46-71%	49%
Partyboats	86-88%	26%
Beach & Bank	23-46%	36%
Man-made Structures	36-44%	39%

Table 6.1 (continued)

C. Percent fishermen trips catching Salmon and Trout[3].

	Ocean[2]	Bay
Private/Rental Boats	0%	2.3%
Partyboats	0%	9.5%
Beach & Bank	0%	0%
Man-made Structure	0%	<1%

D. Percent fishermen trips catching Striped Bass and other Bass fish in category 9[3].

	Ocean[2]	Bay
Private/Rental Boat	0%	5%
Partyboat	0%	7%
Beach & Bank	0-5%	1%
Man-made Structure	0%	1%

E. Percent fishermen trips catching Rockfish, Bottomfish and other fish in category 10[3].

	Ocean	Bay
Private/Rental Boat	32-62%	23%
Partyboat	77-81%	10%
Beach and Bank	0-12%	15%
Man-made Structure	21%	19%

F. Average catch by species for those trips that are successful in catching this species.

Mode/Species	Ocean[2]	Bay
Private/Rental Boat		
Salmon	--	1-2
Bass	--	3.0
Bottomfish/Rockfish	1-3	2.0
Partyboat		
Salmon	--	1.6
Bass	--	1-1.8
Bottomfish/Rockfish	8-9	2-3
Beach and Bank		
Salmon	--	1.5
Bass	1	2
Bottomfish/Rockfish	5-15	1-3

Table 6.1 (continued)

Man-made		
Salmon	--	1-1.3
Bass	--	1.1
Bottomfish/Rockfish	7-9	2.5

G. Average number fishing trips/year (all modes)[4]

	Ocean2	Bay
Mode of interviewed trip		
Private/Rental Boat	16-29	27
Partyboat	5-10	14
Beach and Bank	19-88	46
Man-made Structures	15-43	43

NOTES

1. Source: MRFSS 1981 Intercept Survey, Percentages rounded. Note that this survey was designed to generally not include trips where Salmon and Striped Bass were being targeted. The statistics for these trips may be greatly in error. Statistics for all trips may be biased by this omission.
2. Ocean is a summary of sites in San Mateo, San Francisco and Marin counties. Samples frequently were not taken in San Francisco county for ocean fishing.
3. Catch rates based upon all fishermen interviewed regardless of season. Due to seasons, catch rates by seasons will vary (i.e., generally higher during the prime season). See also note 1.
4. Average number trips biased upward due to intercept procedure which is more likely to sample trips made by more frequent fishermen. For example, assume there are two groups ten fishermen each. Those who take nine trips/year and those who take one trip/year.

	# fishermen	# trip/year	total Trips
Group 1	10	9	90
Group 2	10	1	10
Total (avg.)	20	5	100

The average trips/year per fisherman is five. However, if a 10 percent sample of trips is made one is likely to sample nine trips from Group 1 individuals and one from Group 2 individuals. The estimated average based upon this sample is 8.2 trips/year (9 x 9 + 1 x 1 = 82, 82/100 = 8.2).

Typical trip characteristics (such as distance travelled, fish catch, etc.) do reflect average trip characteristics; which, however, reflect more heavily the characteristics of the more frequent fishermen.

The important characteristics are that most trips are made by participants living within 100 miles of the fishing site, although partyboat trips are taken by participants who, on average, come from greater distances than is the case for other modes. Participants using boat modes have substantially higher probabilities of catching most all fish species, especially those in partyboats. The probabilities of catching Salmon and Striped Bass are much greater for those classified as in the Bay, but similar or lower for those catching Bottomfish. It is important to note that the probability of catching Salmon or Striped Bass are quite low and that those who are successful generally only catch one or two fish of these species on any outing.

6.2.2 Information Required by Travel Cost Models

The types of data necessary to perform the majority of travel cost models, as reviewed in Chapter 3, can be grouped into four categories:

- General trip taking behavior.
- Selected trip information.
- Socioeconomic background information.
- Contingent valuation questions of specific issues.

Many questionnaires also collect data on other related concerns and questions that help to evaluate the effectiveness of the instrument.

The variables considered to be high and low priority in this specific effort were listed in Table 3.1. The table also identifies which data are available from which existing instruments for use on subsequent analyses, such as estimates of fish catch from the MRFSS intercept survey.

The types of data most important to collect in the proposed analysis include:

- General trip taking behavior.

- Seasonal, site and mode distribution data for trips that include Salmon fishing and Striped Bass in the SFBOA. This trip distribution data should include reasonable fine disaggregation of origins, especially for those within 100-200 miles of the site, and of the fishing sites for those sites in or near the study area.

- Information on fishing related expenditures, especially for trips to the study area and for those species of interest. This information should be collected by mode and, if possible, for substitute sites. The analysis is most interested in typical costs, which could be obtained more easily from key informants then through a survey instrument. Nevertheless, the potential other uses to which this survey data may be applied suggest that such expenditures data may be worthwhile to collect in this instrument.

Other data that are desirable to include are:

- Information on preferred species to catch available at the mode site, and season fished and average catch.

- Contingent valuation WTP questions for changes in expected catch rates of Salmon and Striped Bass, WTP for changes in other trip characteristics.

- Costs and catch data for other sites outside of the SFBOA for use in analyzing the probability of trip taking behavior outside rather than inside the SFBOA.

Other design objectives include:

- Avoid collecting interesting data that will not be used or can be obtained elsewhere.

- Target time to complete the instrument at 10-15 minutes.

- Socioeconomics are only needed if individual travel cost models are used for the WTP models. To allow this flexibility, data on income and other variables should be collected.

6.2.3 Survey Approach

There are several survey approaches available including:

1. Personal interview on site using the intercept approach for the complete interview. This would potentially require a relatively long interview to collect all desired data, but allows lots of interviewer guidance.

2. Intercept with telephone follow-up. Follows the MRFSS S/E approach. There are important problems/biases in terms of random sample selection for use in estimating aggregate WTP, and over sampling frequent fishermen in estimating typical fishing behavior and values. Intercept surveys are also the most expensive approach.

3. Mail survey of individuals identified from state fishing license lists. Unfortunately such lists with desired statistical characteristics are not available.

4. Mail survey using fishermen identified on the MRFSS phone survey. Good response rates should be expected as these respondents were previously contacted. The researcher also has control over the number of trips to be sampled by regions and season or other variables identified in the phone survey. The only full survey implementation requirement is to have the MRFSS phone survey adjusted to ask for their participation and address for a follow-up mail survey.

5. Mail/phone survey similiar to a mail survey in that materials are mailed to the respondents then followed up with a telephone interview. This approach has higher costs than either the phone or mail only approachs, but has generally resulted in very high response rates.

The approach selected as the most promising and cost effective was the mail follow-up to the MRFSS phone survey (#4).

6.2.4 The Travel Cost Component of the Survey Instrument

The travel cost (TC) instrument was developed to be implemented in several waves throughout the year. The instrument requests information on trips taken in the last four months and last twelve months to assess seasonal and annual trip taking behavior. Next, data is gathered on the three most recent trips in the last twelve months. A substantial portion of the trips for which detailed data is gathered are expected to have occurred in the last four months. By using this approach one can do a seasonal trip taking analysis with detailed trip data by mode and location for individual fishermen, or one can aggregate the data across fishermen and seasons for a aggregate annual analysis.

For the three more recent trips, data is gathered on the fishing site, fishing mode, distance from their residence to the site, travel time, number of family members on the trip, whether the trip was multipurpose and trip expenditures. Respondents were also asked their target species and catch for Salmon; Striped Bass; Rockfish, Bottomfish and other Flatfish; and for other species. A map was designed to help individuals identify three fishing areas in the SFBOA and two destinations outside of the SFBOA (Figure 6.1).

The approach of conducting the survey in waves throughout the year has several strong advantages to a typical one-shot appoach. It allows the gathering of accurate representative data for an entire year without excessive demands on any respondent and cuts recall problems. It also allows the estimation of many travel models using either a seasonal or annual approach.

The travel cost component of the survey instrument was designed to be completed in about ten minutes.

6.2.5 The Contingent Valuation Component of the Survey Instrument[1]

Contingent valuation method (CVM) questions could be used in at least the following three ways:

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[1] See Cummins et al. (1984) and Rowe and Chestnut (1983) for detailed discussions of contingent valuation methods.

- To provide alternative estimates on values estimated with the travel cost approach. These CVM estimates, if similar to the TC estimates, would provide supportive evidence to the TC estimates. One strength of the CVM in this area is that by focusing upon changes in only one characteristic, values for changes in that characteristic may be more accurately estimated than through the statistical process required in many TC methods.

- To provide estimates of values, or for scenarios, that cannot be estimated with the TC method. Most important among these is valuing changes in resource characteristics, such as expected fish catch, to levels that do not currently exist and where values cannot be inferred accurately from current data; and estimating the value of travel time, which must be assumed with most current travel costs models.

- To provide estimates of preservation values. TC methods deal with estimating only user values. Research to date suggests that non-use, or preservation values, held by non-use members of society may equal or exceed the total user values. (Fisher and Raucher, 1983; Schulze et al. 1981.) Preservation values are, however, outside the current scope of work.

Two issues were selected to be the focus of CVM questions in the pretest. One to value alternative levels of expected catch for Salmon and Striped Bass, and one to examine value of travel time issues. The first focus was selected due to the importance of valuations for the Salmon and Striped Bass component of the SFBOA marine recreational fishery, both at existing levels and for changes that have not, but could occur. Further, the MRFSS data is incomplete in terms of estimating values for the Salmon and Striped Bass fishery.

Both CVM questions focus upon a typical season, or typical trips in a season. It was felt that questions pertaining to a particular trip would be influenced by the satisfaction of that trip, and the fact that the trip is in the past.

Three versions of the CVM questions relating to Salmon and Striped Bass fishing were developed and pretested.

- Version 1: Special Stamp-Payment Card Approach. Examines the WTP for an annual special stamp to Salmon and Striped Bass fish. Alternative payment amounts are listed using a payment card approach (see Mitchell and Carson 1982).

- Version 2: Special Stamp-Iterative Referendum Approach. Again examines WTP for an annual special stamp to Salmon and Striped Bass fish, but an iterative referendum approach is used. Like an iterative bidding approach, respondents are asked whether they would pay $X for a stamp rather than not go Salmon and/or Striped Bass fishing in California. Unlike a bidding approach, preset values are included in the questions, convergence to a final value is not attempted and the results are analyzed with the use of a logit model (see Sellar et al. 1984 for a sample application).

There was some concern that versions 1 and 2 would experience problems due to the use of the special stamp payment vehicle; which the initial results confirmed. Therefore, a third version was developed that is similar to the CVM questions in the National Hunting and Fishing Survey and a recent effort examining marine recreational fishing in southern California (Jones and Stokes, 1985).

- Version 3: Reservation Price - Iterative Referendum Approach. This approach asks whether the individual would still take at least one boat trip each year for Salmon and Striped Bass fishing if the costs for fees and fuel increased by $X per day, where X is varied across four predetermined amounts ($5, $10, $25 and $50). The questions are skipped if no boat trips are taken. Boat trips were selected as the majority of successful Salmon and Striped Bass trips are on boats. Further, it was more realistic for costs to increase on boat trips than for shore trips. The objective of this approach is to estimate the reservation price for Salmon and Striped Bass fishing; which in combination with information on current trip taking behavior and costs and assumptions on the shape of a demand curve can be used to estimate consumer's surplus. This is exemplified with the pretest results in Section 6.3.2.

Versions 1 and 2 were designed to obtain WTP amounts for expected catch at current levels, and at double and one-half of current levels. Version 3 was designed to obtain WTP amounts for expected catch at current levels and double current levels. Two follow-up questions are included in all versions to evaluate the CVM answers. All versions also include questions on typical Salmon and Striped Bass fishing behavior (questions 15 and 16). These questions are included to investigate the relationship between WTP and trip taking behavior, to calculate per trip consumer surplus estimates by individual, and to test whether consumer surplus is different for fishermen with primary interest in Salmon versus Striped Bass fishing.

Questions 21 and 22 attempt to value incremental travel time and fish catch by looking at tradeoffs individuals could make in terms of costs and travel distance. Others (Jones and Stokes 1985) have recently investigated the value of travel time issue for marine recreational fishing by determining what wage the individual could have made had they been able to be working instead of taking a fishing trip. The Jones and Stokes approach is therefore valuing time in travel and fishing. Further, their approach ignores that there may be displeasure or pleasure associated with travel and increasing displeasure associated with additional work thereby affecting the value of travel time in a positive or negative direction for any individual. In short, the wage forgone travel time tradeoff may be misleading. More appropriate tradeoffs would focus upon the experience for which travel time is being undertaken.

6.2.6 Background Information

Several background qeustions were included on socioeconomic variables perceived to be useful in travel cost models. A subjective fishing ability scale was included as trip taking behavior, catch rates and WTP are expected to be positively correlated with ability (Shaw, 1985). Therefore, knowledge of ability would help reduce unexplained variance on the estimates. Question 24 ranks the importance of site attributes. If travel distance and catch are consistently ranked as unimportant, the travel cost and CVM analysis for which this questionnaire is designed may be inappropriate. The importance of the other characteristics will help suggest where future surveys can improve the most in terms of measuring characteristics of importances to fishermen. Question 25 is included as a determinate of mode selection (a fisherman with a boat is more likely to select boat fishing) and to estimate gross expenditures for boat fishing. Other reports are available from which to convert boat characteristics to annualized costs, rather than requiring respondent recall of expenditures. The second part of the question is used to allocate costs to marine recreational fishing. Question 26 provides other annual expenditure data that may not be related to, or reported for, individual trips. However, to the extent that individuals report expenditures for purchases and repairs as a trip cost, there will be double counting.

Questions 27 through 32 are standard socioeconomic variables. Question 32 was included to better analyze and/or estimate the value of travel time as the respondent's wage may not be accurately reflected in the household annual income.

6.3 PRETEST IMPLEMENTATION AND RESULTS

Selected results of the pretest are summarized in Table 6.2. This section reviews results to interpret the effectiveness of the survey instrument and new questions that were developed. As such the results of relatively standard travel cost questions previously used in other surveys are generally not discussed at length or presented in Table 6.2. Conclusions and suggested revisions to the survey procedure and instrument are discussed in section 6.3.3.

6.3.1 Pretest Implementation

An informal pretest instrument was administered during the fall of 1984 to 10 individuals who were professional acquintances of the research team. Based upon the responses from this informal pretest, the instruments were modified and the formal pretest conducted. The formal pretest survey was implemented in two waves during December 1984. Versions 1 and 2 were implemented in early December and Version 3 was implemented at the end of the month. Phone numbers of households in the SFBOA that had participated in a summer wave of the 1984 MRFSS telephone survey were supplied by the NOAA contract manager. These households were contacted during evenings and weekends and asked to participate in a follow-up mail survey that would take approximately 15 minutes to complete and for which they would be compensated $5.00. In total 70 phone numbers were called with the following results.

- Number with no answer or busy signal= 20
- Number where the person participating in marine recreational fishing was not at home and a call back was not completed=5
- Number where a marine recreational fisherman could not be identified or where this was a new number=7
- Number available to participate = 37
- Number refusing to participate =3
- Number agreeing to participate =34

As indicated in Table 6.2 the overall response rate of those 34 individuals to whom questionnaires were mailed was 80 percent. The response rate and speed was higher for Version 1 than either of the other versions, but due to the small sample sizes it is impossible to determine whether this is the result of differences in the sample characteristics across the questionnaires or due to differences in the contingent valuation questions (#17-20). The sample for Versions 2 and 3 included more retirees and a larger share of individuals who took 30 or more marine recreational fishing trips in the last year.

Table 6.2

Summary of San Francisco Bay and Ocean Area Marine Recreational Fishing Survey Pretest

Category	Version 1	Version 2	Version 3	Combined All Versions
# mailed	13	12	9	34
# returned-10 days	11	5	6	22
# returned-21 days	12	9	6	27
# nonuseable returns	0	1	1/2	1 1/2
Time to complete in minutes.-avg. (range)	16 (8-30)	19 (5-40)	30 (5-90)	20 (5-90)
% stating questionnaire easy to complete	100%	87%	80%	92%
Average # trips last 4 months-avg.(range)	4.4 (0-16)	14.9 (0-90)	8.8 (0-35)	8.9 (0-90)
Average # trips last 12 months-avg.(range)	12.5 (1-35)	42.3 (1-200)	25.7 (1-100)	25.4 (1-200)
Average travel costs per mile[1]-avg.(range)	.16 (0-.5)	.16 (0-.75)	.257 (.08-.83)	.18 (0-.83)
% trips with all costs attributable to fishing[2]	89%	95%	100%	93%
Total trips recorded[3]	27	21	13	61
# trips targeting salmon	7	9	1	17
# trips catching salmon	5	6	0	11
Average salmon catch (when caught)	1.6	2.7	--	2.2
# trips targeting striped bass	8	14	6	28
# trips catching striped bass	8	8	1	17
Average striped bass catch (when caught)	2.4	3.9	1	3.0
Average # trips/year typical for (range):				
Salmon in SFBOA	2.8 (0-15)	.6 (0-4)	2 (0-4)	1.9 (0-15)
Striped bass in SFBOA	9 (0-40)	12.6 (0-100)	5.8 (0-25)	9.4 (0-100)
Both salmon and striped bass in SFBOA	6.5 (0-42)	3 (0-20)	5.3 (0-20)	5.1 (0-42)
Salmon or striped bass outside of SFBOA	.9 (0-4)	14 (0-100)	1.7 (0-5)	5.3 (0-100)

Table 6.2
(continued)

Category	Version 1	Version 2	Version 3	Combined All Versions
Salmon & striped bass fishing				
Average consumer surplus for existing situation (per year)[5]	$5.12	$10.00	$100-$240	$5-$200
Change in CS for doubling of expected catch (per year)[5]	$2.50	$5.00	$40-$124	$2.50-$124
Value of travel time as % of wage[5]	45%	50%	65%	50%

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1 Costs per mile calculated as travel and transportation costs (Question 11 entry 4) divided by roundtrip miles calculated from Question 8.

2 Trips where they would not have gone if fishing were not available. See Question 10.

3 Up to 3 trips per respondent. Trips not included if trip data was missing.

4 See Questions 15 and 16. For some individual's typical number of annual salmon and striped bass trips exceeded total trips in the last year.

5 See text for dicussions of calculations.

By and large the returned questionnaires were fully completed and of useable quality. The notable exception were a few questionnaires by retired individuals who occasionally failed to complete a question or group of questions.

The questionnaire was generally deemed easy to complete and was completed in 15 minutes or less. The average completion time was somewhat higher (see Table 6.2) due to a few individuals (again retired) who took considerably longer to complete the instrument. These individuals were frequently the same ones who failed to answer one or more questions.

6.3.2 Pretest Survey Results

Travel Cost Questions

This section discusses the survey results in the order of the questions on the survey instrument. Reported estimates based upon the pretest results must be viewed as suggestive due to the small sample sizes. On the whole the sample behavior in terms of average number of trips taken during the last year are in accordance with estimates from the other surveys discussed earlier in this report (see Table 6.2). A representative proportion of trips by each mode occured in the sample. Well over 90 percent of the trips were to destinations in California and over 80 percent of trips to destinations in the San Francisco Bay and Ocean area (SFBOA). The reported trip characteristics, including expenditures (questions 8-12) were generally consistent with data for similar questions on the MRFSS surveys and other survey instruments reviewed when designing this instrument. They are therefore not discussed further.

As travel costs per mile are an important element to the execution of a travel cost model, Table 6.2 reports the implied travel cost per mile estimates across the sample of 61 trips recorded on the survey. The figure equals the travel and transportation costs (entry 4 question 11) divided by the round trip miles (determined from question #8). The average travel costs per mile estimate is $.18. However, the average travel cost per mile varied from $0.00 to $.83. Much of this variation occurred in calculating this figure for very short trips (1 to 10 miles) where often a figure of a few dollars was listed (leading to very high cost per mile estimates), or nothing was listed for travel costs. As miles traveled to the site increased, the per mile estimate of travel costs was consistently in the range of $.05 to $.18.

Question 10 was asked to ascertain whether a trip was solely for fishing, where all expenses would be attributed to fishing, or whether the trip was multi-purpose, where expenses should be partially attributed to fishing or the observations dropped from the analysis. Only four of the 61 trips for which data was reported were multi-purpose trips where the trip would have been taken even if fishing were not available. Two of these trips were by the same individual. It would seem that ignoring multi-purpose trip issues in subsequent analyses would have minimal impact on the results, but such is not the case. Of the 4 multi-purpose trips, three were long distance trips with much higher than normal expenses. Ignoring the multi-trip issue would be appropriate if one culled their sample of all trips of over some distence such as 200 miles.

Salmon and Striped Bass Fishing

Questions 13 and 14 examined whether on the reported trip the respondent targeted Salmon and/or Striped Bass (perhaps along with other species) and what their catch rate was for these species. Due to the time of year of the pretest it was expected there would be substantial reporting of Salmon and Striped Bass trips. In fact Salmon and Striped Bass were targeted on 28 and 46 percent of the reported trips respectively (both species were targeted on several trips). The target species was caught on over 60 percent of these trips. The average catch, when the fisherman was successful, was 2.2 fish for Salmon and 3.0 fish for Striped Bass. The average catch for all trips targeting these species, whether successful or not, was 1.4 fish for Salmon and 1.8 fish for Striped Bass. Apparently the respondents were interested in catching Salmon and Striped Bass and reasonably successful. Twenty trips were listed as solely for the purpose of catching Salmon and/or Striped Bass. This is important because several of the 1981 and earlier MRFSS telephone survey waves did not collect data on Salmon and Striped Bass trips, apparently substantially understating summer and fall trip taking behavior in this region. It should be noted that the catch rates did slightly increase with the stated level of expertise of the respondent.

Questions 15 and 16 asked about typical trip taking behavior for Salmon and Striped Bass fishing to be used in conjunction with the subsequent contingent valuation questions. The pretest results suggest that Striped Bass fishing is more popular than Salmon fishing and that substantial trips by the survey population are taken outside of the SFBOA (although this is skewed by the effect of one individual in the pretest with over 100 trips per year outside of the study area). It is important to note that the reported "typical" number of trips per year for Salmon and Striped Bass exceeds the stated number of trips for all species in the last year for several respondents. This could be the result of ambiguity remaining in the question, or that the last year (1984) was not representative of typical trip taking behavior.

Contingent Valuation Questions for Salmon and Striped Bass Fishing

Consumer's Surplus Estimates For Existing Conditions. Consumer's surplus measures for changes in the availability of Salmon and Striped Bass fishing were estimated with three alternative contingent valuation question approaches (versions 1-3), as discussed in Section 6.1. The average consumer's surplus values are reported in Table 6.2. The consumer's surplus value for the current availability of Salmon and Striped Bass fishing using the bidding and referendum approaches with payments made through a special stamp for Salmon and Striped Bass fishing (versions 1 and 2) are extremely low, ranging from $5 to $10 per year. These values are the WTP amounts stated for a special stamp minus the current $3.50 stamp fee. It should be noted that the average value using the referendum approach has been approximated as there are insufficient observations to estimate the logit model.

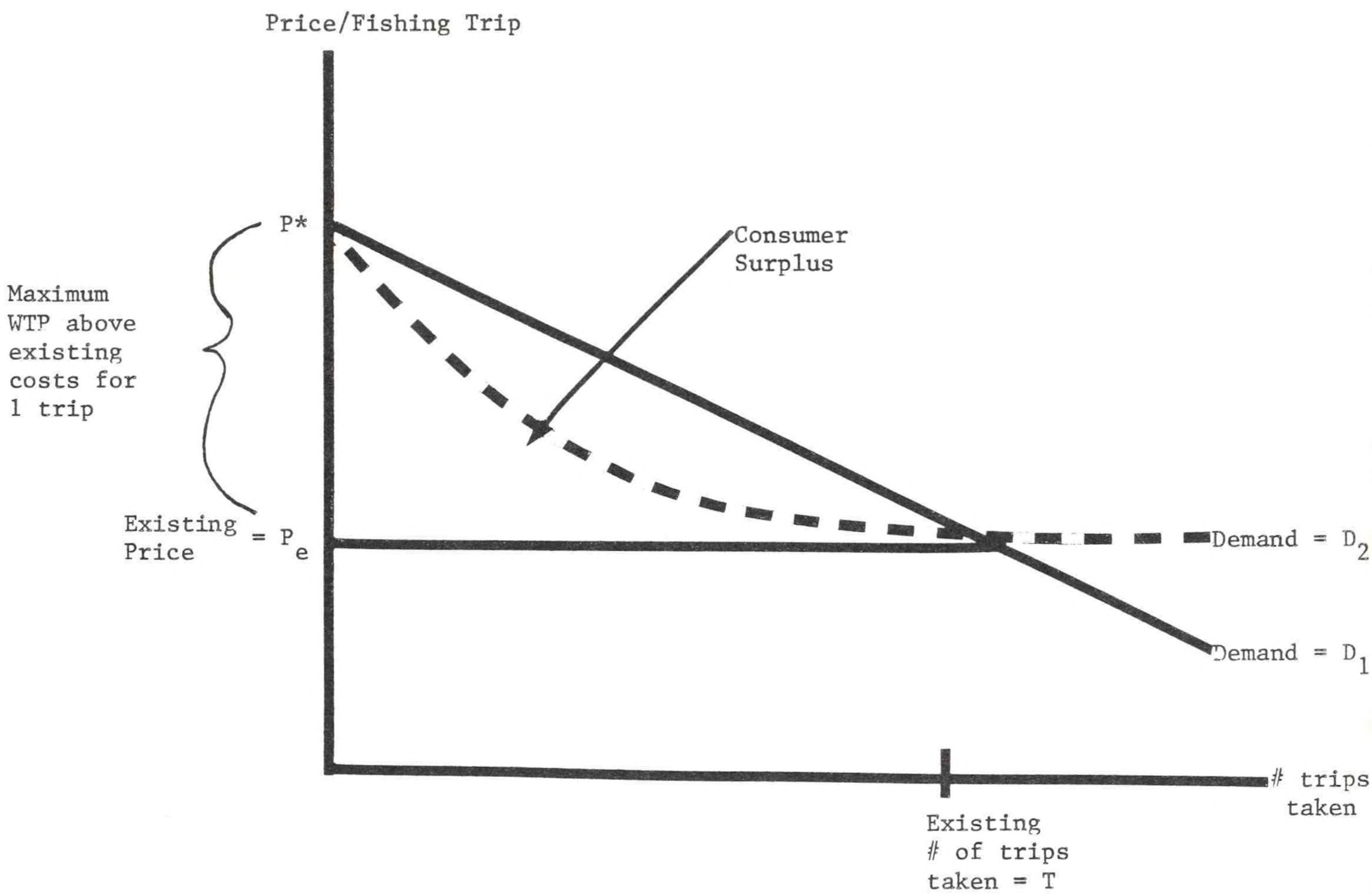
The yearly consumer's surplus estimate for existing levels of Salmon and Striped Bass fishing using the maximum WTP for at least one trip approach (version 3) ranges from $100 to $240 per year. The question asks the maximum increase in per day costs the individual would be willing to pay and still take at least one trip. As such the approach attempts to bound the reservation price at which no further trips would be taken (P* in Figure 6.2). The question iterates through several different values. The last "yes" value (they would pay this increase and still take at least one trip) when added to existing per trip costs is below the reservation price and the first "no" response, when added to existing per trip costs, lies above the reservation price. The consumer surplus for the existing levels of trips is then $1/2 * (P^* - Pe) * T$, assuming a straight line demand curve over the relevant region of analysis, as illustrated with demand curve D1.

The lower end of the estimated consumer's surplus range in version 3 is calculated with the the highest dollar value for which a "yes" response is obtained as the difference between the reservation price P* and the existing price Pe. The higher end of the range is calculated with the first value for which a "no" response is given as that same difference. The lower end of the range is felt to be more defensible as Salmon and Striped Bass trip taking behavior may have been overstated by respondents (T reported in question 16 may be too high); because the first "no" response will overstate the reservation price; and that due to diminishing marginal utility of additional trips taken, the demand curve is likely to be concave toward the origin, as illustrated by demand curve 2 in Figure 6.2, rather than linear. The linear approximation would therefore overstate consumer's surplus. In the full analysis, the travel cost data allow the estimation of the demand curve for use in this analysis.

The consumer's surplus figures using version 1 and 2 are so low as to translate to consumer's surplus values for Salmon and Striped Bass fishing of less than a dollar per trip. The version 3 results translate to consumer's surplus estimates of $5.00 to $10.00 per trip. The particularly low values for versions 1 and 2 are felt to reflect a distaste among fisherman for the special fishing stamp vehicle. In fact several fisherman indicated their maximum WTP was $3.50, the current price of a Striped Bass stamp. It should be noted that with versions 1 and 2, the per trip consumer's surplus estimates are not as large as estimated in previous studies (see Chapter 2), but the version 3 results are comparable to the estimates reported in Chapter 5 of this report using the multinomial logit travel cost model. When asked what they would do instead of Salmon and Striped Bass fishing if the price was

Figure 6.2

Calculation of Consumer Surplus Estimates with Questionnaire Version 3



more than they were willing to pay, the majority of respondents indicated they would fish more for other species. This indicates the importance of accounting for a substitution as in the multinomial logit model. The second most prevalent response was that they would take fewer fishing trips.

Consumer's Surplus Estimates for Changes in the Resource Stock. Contingent valuation questions were asked for willingness to pay to fish for Salmon and Striped Bass if the expected catch rates were to double or to decrease by one-half (see Table 6.2). The WTP estimates for the increase were slightly smaller than for the decrease, which is consistent with the economic tenant of decreasing marginal utility for increasing consumption of a good or service. Again the values estimated through the use of questionnaire version 3 were substantially higher than for versions 1 and 2. Even with the version 3 estimates, the corresponding per trip per person consumer's surplus values for a doubling of the expected catch rates are only $2 to $5, but are again quite similar to those obtained with the multinomial logit mode as reported in Chapter 5. It is important to note that many respondents stated the same willingness to pay regardless of the expected catch levels and some stated that they never caught these species so that doubling catch was not important. The majority of respondents indicated that they would take more Salmon and Striped Bass trips if expected catches were to double.

Contingent Valuation Questions for the Value of Travel Time

Questions 21 and 22 were developed to investigate how different individuals value incremental travel time. Turning to question 22, ranges on the value of incremental travel time can be implied from the pattern of responses to the two halfs of the question. For example, if one is willing to travel 20 additional minutes each way (say 30 miles at a cost of $.12 per mile) to save $10, this implies that their value of incremental travel time is less than $6.10 per 40 minutes, or $9.60 per hour. Similarly, if one is willing to travel an extra hour round trip to save $10 , their value of incremental travel time is less than $4.60 per hour. Of course the exact value of time calculations depend upon the individuals perceived travel costs per mile.

Table 6.2 reports that the implied value of incremental travel time figures roughly average 50 percent of the reported hourly wage rate of the respondent. However, this figure is misleading. The value of travel time estimates showed several consistent and important patterns, even given the small sample sizes. Most importantly, respondents who were very close to fishing sites tended to value incremental travel time much higher than did those who were farther away. Apparently, the value of incremental travel time decreases with increases in the existing level of travel undertaken. Next, the value of travel time was often relatively high (exceeding $9.60/hr) for retirees who were close to the site and had small, or non-existent, hourly wage rates, the ratio of the implied value of travel time to the wage rate is therefore very high for these individuals and dramatically affects the sample wide results. For other non-retired individuals, the value of travel time tended to slightly increase with income, but a consistent pattern of the value of travel time to wages as wages increase was not discernable given the limited sample sizes. Overall, the large majority of respondents answers implied the upper limit of their values of incremental travel time to be in the range of $4 to $9 per hour.

The responses to question 21 require either estimates of the value of incremental fish catch and per mile travel costs to estimate the value of travel time, or estimates of per mile travel costs and the value of travel time to estimate the value of incremental fish catch. This may be much more than the accuracy of the data can support. However, about half of the respondents were willing to travel an extra hour each way to double their expected catch and 74 percent were willing to travel an extra half hour to double their expected catch. Given the estimated value of doubling Salmon and Striped Bass catch indicated by questions 17-20, the implied value of incremental travel time would be near to zero if these answers are valid. On the other hand, using the predominant upper limit on the estimated value of incremental travel time of $4 to $9 per hour from question 22, $.12 costs per mile and 50 miles per hour in travel speed, the implied value of doubling expected fish catch for those willing to travel an extra 1/2 hour each way is no more than $10 to $15 per trip. The implied value for those willing to travel an extra hour each way is no more than $20-$30 per trip. These values are at the upper end of estimates made from other studies, and equal or exceed the multinomial logit estimates reported in Chapter 5.

6.3.3 Suggested Directions

Survey Procedure

The survey procedure of following up with MRFSS telephone participants who were active fishermen appears to be a cost effective manner to achieve a random representative sample of fishermen in the SFBOA. The $5.00 participation gift encouraged a high rate of participation, at a cost must less than developing an alternative sampling procedure. While nearly half of the initial MRFSS phone survey respondents could not be later contacted with only two calls, an approach of requesting respondent participation at the conclusion of the MRFSS phone survey should, with the response rates in the pretest, result in approximately a 70 percent return rate with one mailing. A second mailing may not be required, although it is suggested if response rates are lower than experienced in the pretest.

The next important procedural issue is the sample size required in the full survey. The most demanding travel cost approach in terms of sample size is the multinomial logit approach. The aggregate version of the model can be thought of as a process where one must determine the likelihood (or probability) that a trip from any origin will be taken to any destination and then how the distribution of trips across sites is affected by changes in the site characteristics such as expected fish catch, on-site costs and travel distance. The required sample size will depend upon the number of origins zones to be considered (such as the 11 counties in the SFBOA versus smaller zones defined as groupings of zip code ares), the number of seasons to be considered (6 two month seasons, 3 four month seasons, etc.), the number of destinations to be considered (such as the five depicted in the pretest), the number of fishing modes to be used (2 modes would be shore and boat fishing), and the statistical precision of the estimates.

The sample size must have sufficient observations to accurately determine the probability (Pi) that a trip from an origin in any season will be taken to some site/mode (fishing mode at a site) alternative given current conditions. The distribution of trips from each origin zone in each season can be thought of as a multinomial probability distribution function (Hogg and Craig, 1971) where the sum of the probabilities of taking a trip to each of the site/mode alternative is one. The more site/mode alternatives there are, however, the lower the probability will be that the trip is taken to any one alternative. For example, if there are only two sites and two fishing modes, there are four alternatives. If these four alternatives are equally desirable, the probability of taking a trip to any one is .25. On the other hand, if there are 20 equally desirable site/mode alternatives the probability of taking a trip to any one is .05. This is important because the more alternatives there are, the more likely the probabilities of selecting each alternative will cluster closer togeather at smaller and smaller values. As a result, more observations are required to maintain the same ability to detect statistical differences in the probabilities of selecting the alternatives.

The parameters of a multinomial probability distribution function are the probabilities that a trip will be taken to any site/mode alternative (pi, i=1,2,3...,n where n is the number of alternatives). Each pi is estimated as the number of trips taken to the ith alternative divided by the total number of trips from the origin. The variance of each pi estimate is pi*(1-pi). Assuming a sufficiently large sample so that we may appeal to the Central Limit theorem and assume the estimate of the probabilities are normally distributed, the 90 and 95 percent confidence intervals around alternative estimated pi values based upon different sample sizes are reported in Table 6.3. Confidence intervals are reported for estimated pi values ranging from .1 to .6. In the pretest, 5 alternative sites were defined. If only two modes are defined (shore and boat), then there are 10 alternatives from which to choose to take a trip. If all ten alternatives were equally attractive, the probability of selecting any alternative would be .1. However, most trips are taken to nearby sites. If the probability that a trip is taken to the nearest site is .8 and 75 percent of trips at this site are taken by one mode, then the probability that that site/mode combination will be selected on a trip is .6.

Table 6.3 illustrates that with only 50 observations per season per origin, the confidence intervals on the probability estimates are quite large. For example, one is not able to statistically differentiate between estimates of .2 and .4, with even a 90 percent type I error level. Given such imprecision

Table 6.3

Confidence Intervals Around Estimated Probabilities in a Multinomial Probability Distribution Function

	Alternative Estimated P Values					
	.1	.2	.3	.4	.5	.6
N = 50						
SE(P)	.04	.055	.065	.07	.07	.07
90% Confidence Interval/S	(.03, .17) 70%	(.105, .295) 47.5%	(.195, .405) 35%	(.285, .515) 29%	(.385, .615) 23%	(.485, .715) 19%
95% Confidence Interval/S	(.015, .185) 85%	(.09, .31) 55%	(.175, .425) 41.5%	(.265, .535) 34%	(.34, .64) 28%	(.465, .735) 22.5%
N = 100						
SE(P)	.03	.04	.045	.05	.05	.05
90% Confidence Interval/S	(.05, .15) 50%	(.145, .265) 32.5%	(.225, .375) 25%	(.32, .48) 20%	(.42, .58) 16%	(.52, .68) 13%
95% Confidence Interval/S	(.04, .16) 60%	(.12, .28) 40%	(.21, .39) 30%	(.305, .395) 24%	(.4, .6) 20%	(.505, .695) 16%
N = 200						
SE(P)	.02	.03	.03	.035	.035	.035
90% Confidence Interval/S	(.065, .135) 35%	(.155, .245) 22.5%	(.245, .355) 18%	(.345, .455) 14%	(.44, .56) 12%	(.54, .668) 10%
95% Confidence Interval/S	(.06, .14) 40%	(.145, .255) 27.5%	(.235, .365) 22%	(.33, .47) 17.5%	(.43, .57) 14%	(.53, .67) 12%

NOTES

Probability values and confidence intervals rounded to the nearest .005. Percentages rounded to the nearest .5%.

N = number of observations used to estimate P.

P = estimated probability.

S is one-half the spread of the confidence interval relative to the mean and equals the (upper bound minus the mean)/mean x 100.

in the estimates, one would feel uncomfortable continuing on to use the 10 probability estimates for each site (all clustering in the .00 to .6 range) to evaluate the importance of fish catch and travel distence on site selection. On the other hand the confidence intervals are considerably smaller with 200 observation per site origin zone.

The above sample size considerations lead to the recommendation that all individuals in the MRFSS telephone survey who were active fishermen during the past year be included in the follow-up mail survey. Each wave of the telephone survey generally surveys between 50 and 200 households per county. Assuming 60 percent of the telephone respondents participate in the mail survey and return useable responses, and that 2 trips per respondent will be recorded, as on the pretest, then the mail survey procedure will generate data on 60 to 240 trips from each county in each two month wave. It is recommended that 2 or 3 seasons be used in the analysis so as to more accurately isolate the effect of Salmon and Striped Bass catch rates on trip taking behavior. It is also recommended that many of the counties be broken down into more than one origin zone to more accurately measure average distence to the alternative sites from the different origins. Therefore, it is anticipated that the above procedure will yield from between 150 and 200 observations per origin zone per season.

Questionnaire Design

The survey questions generally appear to be working correctly, but some questions should be revised and a few questions deleted to reduce the time to complete the survey. First, the third and fourth sentence in the paragraph following question 1 should precede question 1. Question 10 could be deleted if one were willing to focus only upon trips of 200 miles or less, which would capture over 90 percent of all trips. Questions 15 and 16 may need to be revised to insure that respondents are not double counting trips into more than one category. The question should also make reference back to the map on page 3. It is recommended that the questions be merged into only two parts with the respondent asked the typical number of trips per year for Salmon and/or Striped Bass in the SFBOA and outside of the SFBOA.

Version 3 appears to be the most effective of the contingent valuation question versions. Question 21 should be deleted. Question 22 has the potential to provide important information on the value of travel time and is recommended for continued inclusion. The survey evaluation following question 32 could be deleted. The survey should be typeset on heavy weight paper for increased ease in reading and handling by the respondents. Production of the questionnaire into a booklet appearance may also assist in improving the response rate as may the production of a higher quality more detailed map with more fishing information on it, which the respondent could keep in appreciation for their participation. The map would also increase the ability to define more site areas, however, as more areas are defined there is increased probability that trips will be taken to more than one site.

The above changes are anticipated to result in a questionnaire with a continued high response rate and a median time to complete of 12-15 minutes. If more reductions are required, questions 14, 24, 22 and 32 would be candidates. Information obtained from question 14 could be replaced with average catch data by site and mode from the corresponding MRFSS intercept surveys. Questions 22 and 24 provide information to validate and refine marine recreation fishing travel cost models in general, but are not critical to this particular analysis if one accepts traditional travel cost model assumptions.

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APPENDIX : MRFSS SURVEY INSTRUMENTS

Intercept Survey - 1981

Phone Survey - 1981

Socioeconomic Survey (S/E) - 1981

APPENDIX : SAN FRANCISCO BAY AND OCEAN AREA SURVEY INSTRUMENTS

VERSION 1: Payment Card Per Season Value

VERSION 2: Referendum Per Season Value (Questions 17-20 only)*

VERSION 3: Iterative Referendun Per Trip Value (Questions 17-20 only)*

*The remaining questions in these versions are identical to version 1.

SAMPLE COVER LETTER

ERC

Energy and Resource Consultants, Inc.

P.O. Drawer O, Boulder, CO 80306 • (303) 449-5515

DATE HERE

ADDRESS HERE

Dear NAME HERE

Thank you for participating in the recent National Marine Fisheries Service telephone survey on saltwater recreational fishing and for agreeing to participate in this follow up survey. Because little is known about saltwater recreational fishing, your responses will help us to better provide and manage striped, bass, salmon and other saltwater fish in central California.

Your responses are very important as only a few household have been selected to participate. As a token of our appreciation of your participation you will receive a $5.00 check upon our receipt of your completed questionnaire. However, we must receive your completed questionnaire by the 22nd of January, 1985.

If you for some reason cannot complete this survey, please have another household member who participates in saltwater recreation fishing complete the survey, or check the no active participants box at the top of the questionnaire. Please return the completed form in the postage paid envelope provided. This data will be coded to retain your complete confidentiality.

Sincerely,

Robert D. Rowe, Energy and Resource Consultants, Inc. Project Manager for the National Marine Fisheries Service

RDR:ma
Enclosures

cc: Dr. Daniel Huppert
National Marine Recreational Fisheries Service
(619) 453-2820

SALTWATER RECREATIONAL FISHING FOLLOW UP SURVEY

IF THERE ARE NO LONGER ANY MEMBERS OF THIS HOUSEHOLD WHO PARTICIPATED IN SALTWATER RECREATIONAL FISHING DURING THE PAST 12 MONTHS, PLEASE CHECK THIS BOX /___/ AND RETURN THE BLANK QUESTIONNAIRE.

THESE QUESTIONS CONCERN YOUR RECENT SALTWATER FISHING. SALTWATER FISHING INCLUDES FISHING IN OCEANS, SOUNDS, BAYS, OR IN TIDAL PORTIONS OF RIVERS. SOME QUESTIONS MAY BE DIFFICULT TO ANSWER EXACTLY. PLEASE PROVIDE YOUR BEST ANSWER.

TRIP RECORD

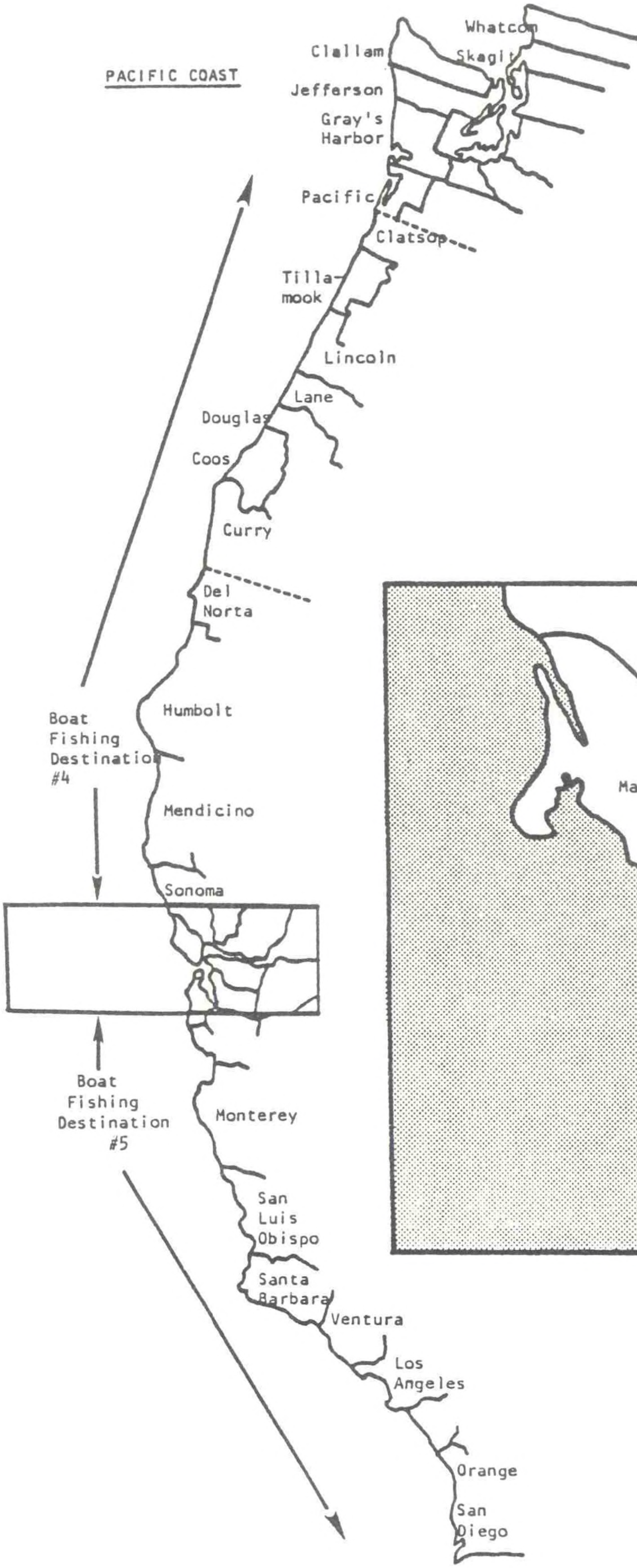
#1. How many times did you go saltwater recreational fishing in the last 12 months? __________

How many times did you go saltwater recreational fishing in just the last 4 months? __________

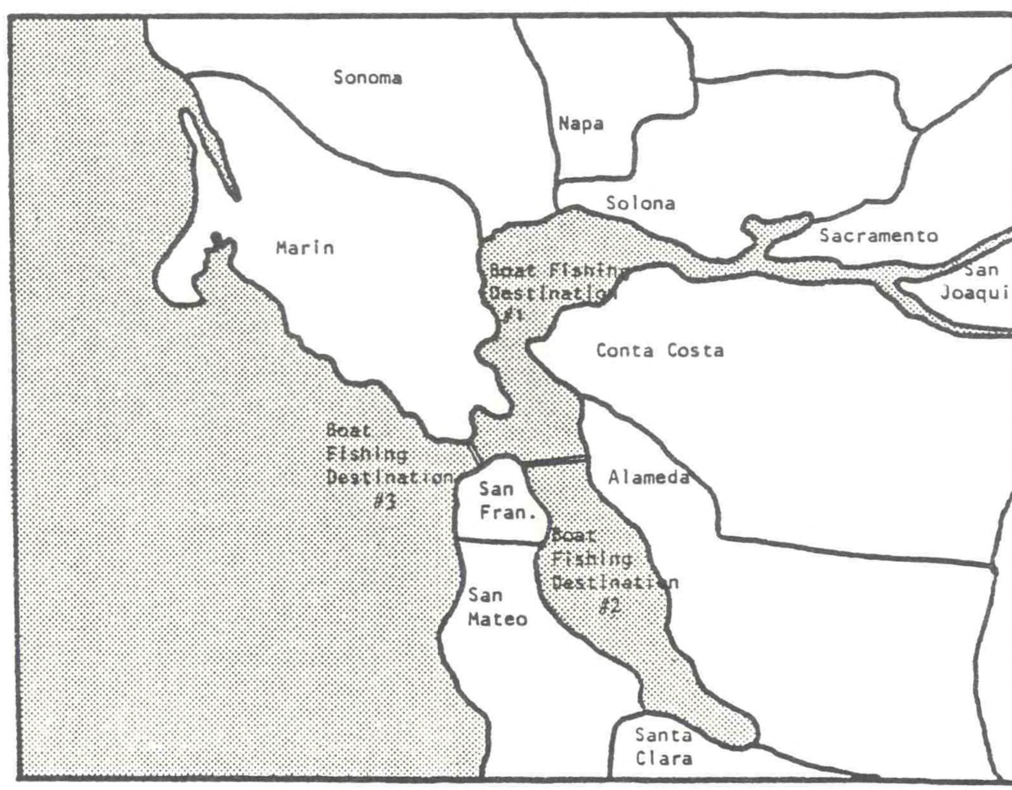
PLEASE ANSWER QUESTIONS #2 THRU #14 FOR THE 3 **MOST RECENT TIMES YOU WENT SALTWATER RECREATIONAL FISHING.** IF YOU WENT FEWER THAN 3 TIMES IN THE LAST 12 MONTHS, ANSWER THE QUESTIONS ONLY FOR THE TIMES YOU DID FISH IN THE LAST 12 MONTHS. PLEASE CONSIDER EACH TIME YOU WENT FISHING AS A FISHING TRIP, WHETHER IT WAS FOR AN HOUR OR FOR A COUPLE OF DAYS. YOU MAY FIND IT EASIER TO ANSWER ALL QUESTIONS FOR YOUR MOST RECENT TRIP, AND THEN ALL QUESTIONS FOR YOUR NEXT MOST RECENT TRIP AND SO FORTH.

	MOST RECENT TRIP	2ND MOST RECENT TRIP	3RD MOST RECENT TRIP
#2. In what month did you take this trip?	________	________	________
#3. Please check if on this trip you fished primarily from:			
a. Beach or bank	________	________	________
b. Pier, jetty, dock or other man-made structure	________	________	________
c. Party or charter boat	________	________	________
d. Private or rental boat	________	________	________
#4. In what State did you fish or launch from?	________	________	________

	MOST RECENT TRIP	2ND MOST RECENT TRIP	3RD MOST RECENT TRIP
#5. If you were fishing from a beach, bank or man-made structure, in what county were you fishing? (SEE MAP)	________	________	________
#6. If you were fishing from a boat, what county did you launch from? (SEE MAP)	________	________	________
#7. If you fished from a boat please note the AREA # of your <u>primary fishing destination</u>. (SEE MAP)	________	________	________
#8. About how many miles is it one-way from your residence to the fishing or boat launching site?	________	________	________
#9. About how long did you fish on this trip (2 hours, 4 hours, etc.)?	________	________	________
#10. Sometimes people combine fishing trips with other activities. Was this trip just for fishing? (YES/NO)	________	________	________
Would you have made this trip if there were no fishing available? (YES/NO)	________	________	________
#11. How much did you spend on this fishing trip for each of the following? (If you had no expenses please put $0.00. If you do not remember, please put your best estimate.)			
Tackle, bait, rental equipment, licenses, and fish cleaning:	$______	$______	$______
Boat fees and fuel.	$______	$______	$______
Food, beverages and lodging	$______	$______	$______
Travel and other transportation costs.	$______	$______	$______
#12. How many other family members were with you on this trip?	________	________	________



SAN FRANCISCO BAY AND OCEAN AREA



#13. Please check the categories that describes what you were hoping (or targeting) to catch on this trip.

--No particular species, whatever I could catch.	________	________	________
-- Salmon	________	________	________
--Striped bass	________	________	________
__Rockfish, ling cod or other bottomfish.	________	________	________
--halibut, sole or flatfish	________	________	________
--Other species	________	________	________

#14. Please list how many of each of the following species you caught on each fishing trip. (Please give your best guess even if you do not remember exactly.)

--Salmon	________	________	________
--Striped bass	________	________	________
--Rockfish, ling cod or other bottomfish.	________	________	________
--halibut, sole or flatfish	________	________	________
--other species	________	________	________

STRIPED BASS AND SALMON FISHING

THE NEXT QUESTIONS ASK ABOUT YOUR FISHING TRIPS FOR STRIPED BASS AND SALMON. WE ARE CONCERNED ABOUT PROTECTING THE SALMON AND STRIPED BASS FISHING AND WANT TO FIND OUT HOW CHANGES IN THESE FISH POPULATIONS AFFECT YOUR FISHING ENJOYMENT.

IF YOU DO NOT FISH FOR STRIPED BASS OR SALMON SKIP DOWN TO QUESTION #23.

#15. Based on the last few years, how many times each year do you typically go striped bass and salmon fishing in the San Francisco Bay and Ocean Areas. (SEE MAP)

_____# Times/year fishing primarily for SALMON in the San Francisco Bay and Ocean Area.

_____# Times/year fishing primarily for STRIPED BASS in the San Francisco Bay and Ocean Area.

_____# Times/year fishing for both SALMON and STRIPED BASS in the San Francisco Bay and Ocean Area.

#16. Based on the last few years, how many times each year do you typically fish for striped bass or salmon outside of the San Francisco Bay and ocean area?

_____# Times per year.

In many years a special stamp is required to fish for striped bass and/or salmon in California. These monies are used to provide funds to reserach striped bass and salmon problems, and to better manage and protect these fish and the waters they live in and spawn in.

The next questions are asked to help us better understand how important striped bass and salmon fishing are, not to set fishing license fees. These questions ask if you would pay different amounts for a special California fishing license stamp covering both striped vass and salmon fishing. For these questions please remember that without the hypothetical fishing license stamp you would be unable to fishing for either striped bass or salmon in California.

#17. Even with more funding, average catches of salmon and striped bass could still decrease. What is the **MOST** you would pay each year for a special striped bass and salmon stamp if you could expect your catch of striped bass and salmon to be **only one-half of what currently expect to catch**? (Circle the amount)

$0.00	$1.00	$3.50	$5.00	$10.00	$12.50	$15.00
$20.0	$25.00	$30.00	$35.00	$40.00	$50.00	$60.00
$70.00	$80.00	$90.00	$100.00	$110.00	$125.00	$150.00

#18 What is the **MOST** you would pay each year for a special California striped bass and salmon stamp if you could expect your catch of striped bass and salmon to **remain at current levels?** (Circle the amount)

$0.00	$1.00	$3.50	$5.00	$10.00	$12.50	$15.00
$20.0	$25.00	$30.00	$35.00	$40.00	$50.00	$60.00
$70.00	$80.00	$90.00	$100.00	$110.00	$125.00	$150.00

#19. With additional funding from fishing license stamps, the population of salmon and striped bass may be able to increase. What is the **MOST** you would pay for a special California striped bass salmon stamp if you could expect your average catch of striped bass and salmon to **DOUBLE**? (Circle the amount).

$0.00	$1.00	$3.50	$5.00	$10.00	$12.50	$15.00
$20.0	$25.00	$30.00	$35.00	$40.00	$50.00	$60.00
$70.00	$80.00	$90.00	$100.00	$110.00	$125.00	$150.00

#20. If you circled $0.00 for any of Questions #17, 18 or 19, which of the following **BEST** explains why?

_____I am not interested in striped bass and salmon fishing at the expected catch rates given in the question.

_____I am not willing to, or cannot afford to pay more to go striped bass or salmon fishing in California and would stop going.

_____I am opposed to more fishing license fees and would not fish for striped bass and salmon.

_____I am opposed to more fishing license fees being used in these question.

_____Other. Please specify.________________________________

#21. Compared to the site where you usually go to fish for salmon or striped bass, if an alternative site were available where your fishing costs would be the same, but your expectered average catch would be double,

-Would you then usually fish for salmon or striped bass at the alternatvie site if it were an extra one-half hour drive each way?

_____**YES** (CONTINUE) _____**NO** (GO TO #22)

-Would you then usually fish for salmon or striped bass at the alternative site if it were an extra hour drive each way?

_____**YES** (CONTINUE) _____**NO.**

#22. Compared to the site where you usually go to fish for salmon or striped bass, if an alternative site were available where your fishing costs, in terms of boat fees, equipment rental, tackle, bait, etc., were $10.00 less and your expected average catch were the same,

-Would you then usually fish for salmon or striped bass at the alternative site if it were an extra 20 minutes drive each way?

_____**YES** (CONTINUE) _____**NO** (GO TO #23)

- Would you then usually fish for salmon or striped bass at the alternative site if it were an extra one-half hour drive each way?

_____**YES** _____**NO.**

BACKGROUND INFORMATION

#23. Please circle the number on the following scale that you feel best describes your saltwater fishing ability.

1	2	3	4	5
NOVICE		INTERMEDIATE		ADVANCED

#24. Please check whether the following are **VERY IMPORTANT, IMPORTANT or NOT IMPORTANT** in selecting the sites where you most often go fishing.

	Very Important	Important	Not Important
Travel distance from home, business or vacation site	____	____	____
Species, size and number of fish you expect to be able to catch	____	____	____
Facilities at the fishing or launch site	____	____	____
Crowding at the fishing site	____	____	____
Weather and water conditions	____	____	____
Scenic beauty at the fishing sites	____	____	____
Other (specify______________________________)	____	____	____

#25. Do you own or operate a boat that can be used for saltwater fishing?

_____ **NO.** (GO TO QUESTION #27)

_____ **YES.** IF YES, How long is your boat? ______feet.

About what percent of the time was your boat used for saltwater fishing rather than for freshwater fishing, cruising or other activities? ______percent.

#26. In the last 12 months, how much did you spend for purchases or repairs on saltwater fishing gear and equipment (excluding boats, motors, trailers and boat-related equipment)? $_______.

#27 In what year were your born? _____

#28. Check the category that best describes your employment status.

_____Employed full time.
_____Employed part time.
_____Homemaker.
_____Unemployed.
_____Retired.
_____Student.

#29. Are you male or female?
_____male
_____female

#30. How many family members live in your household? _____ people.

#31. Check the category best describing your household annual income before taxes.

_____ $ 0,000-$10,000.
_____ $10,001-$15,000.
_____ $15,001-$20,000.
_____ $20,001-$25,000.
_____ $25,001-$30,000
_____ $30,001-$40,000.
_____ $40,001-$50,000.
_____ $50,001-$60,000.
_____ $60,001-$75,000.
_____ Greater than $75,000

#32. Please check which category best describes your own wage per hour.

_____$ 0.00-$ 5.00/hr.
_____$ 5.01-$10.00/hr.
_____$10.01-$15.00/hr.
_____$15.01-$20.00/hr.
_____$20.01-$25.00/hr.
_____$25.01-$30.00/hr.
_____ Over $30.00/hr.

Thank your for completing this questionnaire. The results of this survey will prove useful in the formulation of fisheries management and protection policies.

PLEASE TAKE A MOMENT TO HELP US EVALUATE THIS SURVEY.

HOW LONG DID IT TAKE YOU TO COMPLETE THIS QUESTIONNAIRE?

__________Minutes

OVERALL, WAS THE QUESTIONNAIRE:

______EASY TO ANSWER
______SOMEWHAT HARD TO ANSWER
______VERY HARD TO ANSWER

PLEASE INDICATE THE NUMBERS OF ANY QUESTION THAT

WERE CONFUSING. #'S ______________

PARTICULARLY DIFFICULT TO ANSWER ACCURATELY. #'S ____________________

PLEASE ADD ANY CONSTRUCTIVE COMMENTS THAT YOU HAVE REGARDING THIS QUESTIONNAIRE.

Please list in the space below the address to which we should send the copies of the **ANGLER'S GUIDE Charts** which we promised.

Name ______________________________

Street______________________________

City______________ State______________

ZIPCODE______________

VERSION II QUESTIONS 17-20

In many years a special stamp is required to fish for striped bass and/or salmon in California. These monies are used to provide funds to reserach striped bass and salmon problems, and to better manage and protect these fish and the waters they live in and spawn in.

The next questions are asked to help us better understand how important striped bass and salmon fishing are, not to set fishing license fees. These questions ask if you would pay different amounts for a special California fishing license stamp covering both striped vass and salmon fishing. For these questions please remember that without the hypothetical fishing license stamp you would be unable to fishing for either striped bass or salmon in California.

#17. If you were to expect your average catch of striped bass and salmon to be **only one-half of what you currently catch**, would you buy a special California striped bass and salmon fishing license stamp if it cost **$15 per year?**

____**NO** (GO TO QUESTION #18)

____**YES** Would you buy a special California striped bass and salmon fishing stamp if it cost **$40/year?**

____**NO** (GO TO QUESTION #20)

____**YES.** Would you buy a special California striped bass and salmon fishing stamp if it cost **$75/year?**

____**YES**

____**NO**

#18. If you could expect your average catch of striped bass and salmon to **remain at current levels** would you by a special california striped bass and salmon fishing stamp if it cost **$ 15/year?.**

____**NO** (GO TO QUESTION #19)

____**YES** Would you buy a special California striped bass and salmon fishing stamp if it cost **$40/year?**

____**NO** (GO TO QUESTION #20)

____**YES.** Would you buy a special California striped bass and salmon fishing stamp if it cost **$75/year?**

____**YES**

____**NO**

#19. With additonal funding from fishing license stamps, the populations of striped bass and salmon may be able to increase. If you could expect that your **catch of striped bass and salmon to double,** would you buy a special striped bass and salmon license stamp if it cost **$15/year?**

_____**NO.** (GO TO QUESTION #20).

_____**YES.** Would you buy a special California striped bass and salmon fishing stamp if it cost **$40/year?**

____**NO.** (GO TO QUESTION #20)

____**YES.** Would you buy a special California striped bass and salmon fishing stamp if it cost **$50/year?**

__/__**NO**

_____**YES**

#20. If a special salmon and sttiped bas license stamp cost more than you are willing to pay, which of the following explains what you would do instead of going salmon and striped bass fishing in California.

_____Fish for salmon and stiped bass in other states or private lakes.

_____Fish more for other species (other saltwater fish or freshwater fish).

_____Take fewer fishing trips.

_____Other. Please explain.______________________________________

VERSION III QUESTIONS 17-20

IF YOU DO NOT FISH FROM BOATS FOR SALMON OR STRIPED BASS, SKIP TO QUESTION 19.

#17. Would you still take at least one boat trip for salmon and striped bass each year **if your costs for boat fees and fuel increased by:**

$5/day?

________YES (continue) _______NO (GO TO #18)

$10/day?

________YES (continue) _______NO (GO TO #18)

$25/day?

________YES (continue) _______NO (GO TO #18)

$50/day?

________YES (continue) _______NO (GO TO #18)

#18. If the costs of boat fishing for salmon and striped bass fishing were more than you would be willing to pay, which of the following explains what you would do instead?

_____Fish more for salmon and striped bass from the shore, piers docks or other man-made structures.

_____Fish more for other species (other saltwater fish or freshwater fish).

_____Take fewer fishing trips.

_____Other. Please explain.____

#19. Would you take more, less or about the same number of salmon or striped bass boat fishing trips in the San Francisco Bay area if your expected catch per trip were to DOUBLE and your costs per trip remained the same?

______ Fewer boat fishing trips for salmon and striped bass.

______ About the same number of boat fishing trips for salmon and striped bass.

______ More boat fishing trips for salmon and striped bass.

#20. If your expected catch per trip for salmon and striped bass to **DOUBLE**, would you still take at least one boat trip for salmon and stiped bass each year <u>if your costs for boat fees and fuel increased by:</u>

$5/day?

________YES (continue) ________NO (GO TO #21)

$10/day?

________YES (continue) ________NO (GO TO #21)

$25/day?

________YES (continue) ________NO (GO TO #21)

$50/day?

________YES (continue) ________NO

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