Chapter 6

The Benefits for Recreational Fishing: Striped Bass

This chapter provides come preliminary estimates of the increase in benefits to sport anglers from increases in water quality. We use a portion of the 1980 National Survey of Fishing, Hunting and Wildlife Related Recreation, referred to as USFWS data, to estimate the demand for and value of fishing for striped bass in Maryland. This survey, while not designed for these purposes, is the only data aet currently available which enables us to investigate the recreational fishing of the Chesapeake. Striped bass is the only specie. important to the Chesapeake Bay recreational fishery for which there is sufficiently detailed-catch information to link water quality changes to the benefits of sportfishing.

The link between improved water quality and changes in recreational fishing demand depends on the ecological connection between water quality and catch rates and the behavioral connection betwean catch rates and fishing activities. Descriptive and analytic studies of the Bay have focused on the impacts of water pollution on the density and productivity of fish stocks. Lower dissolved oxygen, declines in SAV, and increases in water toxicants all appear to have an impact on fish stocks. Further, where records are kept for commercial fisheries, there haa been a substantial decline in landings per unit effort, especially for those species which spawn in the Bay or ita tributaries

It is plausible to expect considerable benefits to recreational fishermen from improvements in water quality. The number of recreational anglers is quite large, baaed on information from the primary sources of data on saltwater recreational fishing in Maryland. Estimates of saltwater fishing participation in Maryland during 1980 range from 539,000 anglers over 16 years of age taking 4.1 million trips to somewhat over 800,000 anglers of all age. taking 2.7 million trips (U. S. Fish and Wildlife Service and Bureau of Census; U. S. National Marine Fisheries Service; William et al.). According to NMFS and State of Maryland data, each saltwater angler took approximately three trips, while USFWS estimates approximately 7.6 trip. and 9.0 days fished per angler.

Data on striped bass fishing are somewhat more difficult to obtain. According to the Maryland Department of Natural Resources, roughly 203,000 of the saltwater trips were for stiped bass. Our analyais of the USFWS data indicates that 239,000 anglers (over 16 years of age) fished for striped bass in Maryland and Sussex County, Delaware, fishing for approximately 2.1 million days, or roughly 8.8 days per angler. Estimates of the striped baas recreational catch in Maryland range from 211,000 to 377,000 fish, a total weight of 200 to 474 metric tons. The USFWS data are not well suited for estimating aggregate catch, because the survey used waa designed primarily for other purpose., even though catches are self-reported by respondents for come saltwater species, notably striped bass.

Table 6.1 provides some descriptive information about the sample of anglers which was analyzed in this portion of the study. The sample was partitioned into two groups baaed on whether the individual fished for striped bass or not. Individuals in the two subsamples are very similar in the amount of fishing and hunting done and in their exprience, income, age, education, and other demographic makeup, Striped baea fishermen, on average, showed a slightly higher propensity to own a boat and to allocate more money to hunting and fishing activities, though these differences are not significantly different from zero due to the high within-subsample variation.

Table 6.1

Characteristics of Striped Bass Fishermen and Other Fishermen and/or Hunters in the Sample

	Striped Baaa Fishermen	Non-Striped Baaa Fishermen
Number of Individual in Sample	184	576
Average Number of Days Fishing, Striped Baas	11 daya	0 days
Average Number of Days Fishing, All Species	28 daya	2'7 daye
Percent Who Also Hunted	41%	37%
Average Number of Days, Hunting	17 daya	15 days
Average Years of Fishing Experience	24 years	24 years
Average Age When First Fished	10	12
Percent Owning Inboard Boat	19%	7%
Percent Owing Outboard Boat	42%	28%
Percent owning Other Boat	17%	12%
Average Household Income	$28,300	$27,600
Average Fishing/Hunting Budget in 1980	$982	$588
Average Age[a]	38	38
Average Years of Schooling	13 years	13 years
Percent Working in Job or Business	70%	73%
Percent from Urban Areas	44%	38%

[a]The sample is for individuals 16 yeara of age and over.

A Description of the Data

The 1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation was the source data *for analysis.* Of the available data sets on Chesapeake Bay sportfishing, the portions *of* this survey relating to saltwater recreational fishing in Maryland, and by Maryland residents, offered the best prospects for modelling the effects of water quality improvements. This data set oontained the essential variables for estimating recreational fishing demand functions, including information on (a) trips *taken* by destination; (b) costs incurred by recreationists *for* goods and services used in recreation; (c) household income; and (d) catch rates reported by anglers for certain species.

The survey consisted of two parts. The first was a telephone screening of households, predominantly by telephone interviews, to collect demographic characteristics and to determine the hunting, fishing, and non-consumptive recreation activities *of* household members during 1980. The second part was a detailed questionnaire administered (typically in person) to selected individuals who indicated they had hunted or fished in 1880, collecting information on activities and expenditures. Of the 30,300 fishermen and hunters and 6,000 non-consumptive users interviewed nationwide, 760 pursued some or all of these activities in Maryland. These 760 individuals were the subject of this analysis.

Of the 760 who hunted, fished or Participate in non-consumptive wildlife-related activities in Maryland, 456 indicated they participated in some form of saltwater fishing. Catch rate estimates were only obtained for a limited number of saltwater and estuarine species, with striped baas the only recorded species relevant to Maryland. One hundred eighty-four individuals indicated they fished *for* striped baas in 1960.

The survey waa designed to provide estimates of recreation activities and expenditures at the state level, and states were divided into large subregions for purpose. *of* identifying trip destinations. Maryland was divided into four such regions, three of which border the Chesapeake and were the location of striped bass fishing. Broadly defined, the four areas are: the Southeastern Chesapeake region, Northern Chesapeake, Southwestern Chesapeake, and Northwestern Maryland. Significant numbers of Maryland residents also fished for striped baaa in Sussex County, Delaware. Of the 184 striped bass fishermen in the *sample,* 16 reported fishing in Delaware, 46 indicated they fished for striped baaa in the Northern Chesapeake, 59 fished *in* the Southeastern Chesapeake region, and 86 in the Southwestern Chesapeake (Table 6.2).

The data aet includes days fished for ● trtped bass and other species, rather than number of trips by specie., the latter being the preferable measure for travel cost models. The survey did, however, include the total number of trips to each region. Aggregating over all areas to get total trips and all species to get total days fished, it was determined that anglers took about 4.1 million trips and fished about 4.8 million days, yielding an average of 1.17 days/trip. Thus, the two measures may not be bad approximations *of* one another.

Table 6.2

Sample Distribution Number of Fishermen, Days of Striped Bass Fishing in 1880, and Catch Rate, By Regions

Region	Number Who Visitad	Mean Striped Baas Days	Mean Catch Rate Fish/Day
Sussex DB	16	6.8	4.4
Northern Chesapeake[a]	46	9.6	4.9
Southeastern Chesapeake[b]	59	11.3	3.3
Southwestern Chesapeake	88	8.8	2.8

'Baltimore City and Bait imore, Carroll , Cecil , Harford, Kent , and Queen Anne's counties.
[b]Carol ine, Dorcester, Somerset, Talbot, Wicomico, and Worcester count ies.
[c]Anne Arundel, Calvert, Charles, Howard, Montgomery, Prince George's, and St. Mary's counties.

While detailed information was collected on costs of travel, lodging, food, fees, and other expenses incurred during recreation trip., these costs were not area specific; instead total expenditures over all saltwater fishing trips to all areas (regardless of species sought) were collected for eaoh cost category. The variable cost of trips to a single area could be determined only by prorating total variable costs according to distance travelled. The method ueed in this analysis waa to determine the total miles travelled by the individual for all saltwater fishing trip. in 1980, aa the •m of products of round trip miles travelled to (the usual fishing location in) each area and the number of trips taken to each area, The fraction of total variable fishing expenses prorated for eaoh trip to each site waa the round trip miles travelled to the site divided by total miles travelled. The money coat of a trip to each site waa this fraction times the reported total variable costs for saltwater fishing. Espressed as a formula,

$$MC_{ij} = [M_{ij} / \sum_{k=1}^{n} M_{ik} \bullet_{ik}] VC_i$$

where MC_{ij} is the money coat of a trip by individual i to area j, M_{ij} is the round trip miles travelled by individual i to area j, $\bullet_{ij}$ is the number of trips ' individual i takes to area j, VC_i is individual i'. reported saltwater fishing variable costs, and there are n areaa.

The coat of time spent in recreation is also an important determinant of demand. The •urvey data were not ideal for determining this coat because no

information was collected on the time spent in travel or at the site on each trip. However, miles traveled is a reasonably good proxy for time spent in travel. The procedure used here waa to assume an average rate *of* speed during travel of 40 miles per hour and that the annual household income divided by the number of hours in the average full-time work year (2,040) was a suitable *approximation* for the wage rate. Then, the value of *time* travelled was determined as the product of the amount *of* time spent in travel and 40 percent of the wage rate. Expressed as a formula,

$$TC_j = \left(\frac{M_{ij}}{40}\right)(.4)\left(\frac{y_i}{2,040}\right)$$

$$= M_{ij}\left(\frac{y_i}{204,000}\right),$$

where TC_{ij} is the time coat for individual i travelling to area j, y_i is the household of person i, and M_{ij} is, again, round-trip miles. Of course, this is a rather arbitrary formulation for time cost based on a series *of* restrictive assumptions, but preferable ways of treating the value of time were not possible given the available data. The full price of a trip is then calculated as the sum of the time and money prices for each individual $TP_i = MC_i + TC_i$.

In the survey, respondents were asked to estimate their average catch rate per day *for* selected species. Unfortunately, there was a lag *of* up to a year or more between the time the *fishing* trip was taken and the time the questionnaire was answered. There is evidence (e.g. Deuel, Hiett and Worrall) that fishermen do not accurately remember numbers of fish caught or their sizes well beyond a period of a few months. A comparison of the USFWS data and data collected by the State of Maryland suggests that the USFWS data might contain an upward bias in reported catch rates. The sample and population average catch rates were both somewhat over three striped bass per day, which is considerably higher than the State of Maryland data which suggests a catch rate for the came period *of one* striped bass per day. When the sample catch rates were extrapolated to estimate total 1980 catch, the estimate was an order *of* magnitude or more larger than the published estimates noted in the introduction, although some of this difference may be attributable to difference. in estimates baaed on total trips versus total days. The fact that sample catch rates do not predict aggregate catch well does not invalidate their uae as quality indicators, however. As indicators of the quality factors which signal individuals' fishing decisions, sample catch rates may perform quite well.

The survey data contained a categorical variable measure of household income. A second measure was also calculated: total budget for fishing and hunting recreation, the sum of all fishing and hunting-related expenditures *in* 1980. If the individual has a weakly separable utility function and determines first the total amount of income to allocate to hunting and fising recreation,

the fishing and hunting budget to a more relevant income constraint than overall household income. The fishing/hunting budget measures, however, is subject to potential errors Of measurement, both from faulty recall by respondents and from year-to-year fluctuations due to purchase of major durable goods.

The Basic Model

For a variety *of* reasons, the model we estimate *for* recreational fishing is different from the recreational beach uee and boating model. In the beach use and boating estimations, trip data existed for a number of quality-differentiated sites. In the fishing data, trips are available only by region. There are only *four* of these regions, and each is large so there can easily be as much variation within any region M there in among the regions. Further, 164 of the 184 striped bass anglers in the sample visited only one region. Rather than estimating four demand curves, we have estimated a single equation where the dependent variable is the sum of the trips to all sites.

The handling of the quality variables differs al- For recreational boating, w. ueed a varying Parameter model because the quality variable, scientific measures of water quality, varied across sites but not across individuals. The quality variable in recreational fishting, catch rate, varies across individuals. Consequently, we need not use a varying parameter model. Instead we uee the observation on the reported catch in arena where the individual took his trips. The data set includes many individuals who did not fish *for striped* bass. For these individual, costs and catch rates were inferred.

The *fishing* model estimated waa

$$x_i = \beta_0 + \beta_1 TC_i + \beta_2 CR_i + \beta_3 IB_i + \beta_4 CB_i + \beta_5 BD_i \tag{6.1}$$

where xi is the number of days taken by the i^{th} individual, TC_i is the individual'. full coat (in dollars per trip) of striped bass fishing, CR_1 is the catch rate (fish per day), IB_1 and OB_i are (0,1) variables denoting availability *of an* inboard or outboard boat for fishing, respectively; and BD_i is the individual'. fishing/hunting budget in dollar. per year.

No eubatitute sites were specified in the model because the regions were so broadly defined that they might not in fact act as substitutes for each other. There is probably extensive substitution among sites within each region that cannot be captured at all given the level *of* aggregation we face; and the sample data indicates that only about 10 percent of respondents visited more than one region. Instead, the price and catch rate *for Participant* who visited more than one site were calculated as the mean of price. and catch rate. at each region visited, weighted by the day. fished.

Only slightly more than one-quarter *of* the respondents who either hunted or fished in Maryland reported having fished for striped bass. This level of

non-participation implies a serious censored variables problem. There are several ways of handling this problem in recreational demand models. We explore these approaches in Chapter 4 *of* Volume I of this report. For the current task of estimating fisheries demand models, we choose the following simple Tobit formulation:

$$x = \begin{cases} \beta' z + \varepsilon & \beta' z + \varepsilon > 0 \\ 0 & \beta' z + \varepsilon \leq 0 \end{cases} \tag{6.2}$$

where z is the vector of explanatory variable.. The Tobit model imposes come rather extreme restrictions on individual behavior that more general sample selection models avoid. But *for* preliminary results, we accept these restrictions for the sake of simplicity.

Determining the relevant price and catch rate *for* non-participants was problematic. For these individuals, it was not known which of the *four* price-quality combinations were moat relevant to their decision to go/not go striped bass fishing. In the application we used the minimum price to access a striped bass "site" and its corresponding catch rate.

Welfare measures are calculated, in principle, the " same way as for the varying parameter. model. That is, the benefits of an increase in catch rates are given by the change in consumer'a ● mplua which, for the linear model above, is

$$\Delta CS = \frac{x^2(CR^1)}{-2\hat{\beta}_1} - \frac{x^2(CR^0)}{-2\hat{\beta}_1} \tag{6.3}$$

where β_1 is the *own-price* coefficient, and x is the individual's trip level.

Empirical Results

The model in equations (6.1) and (6.2) was estimated using the maximum likelihood method of LIMDBP. Table 6.3 gives the results which will be used for preliminary benefit estimation, along with the sample means of the variables. The results in Table 6.3 are *for* a model in which actual catch rates reported were used for participant, and a predicted catch rate was used for non-participants. We also estimated a model in which predicted catch rates were used for every individual In the latter estimation, the coefficient estimates remained basically unchanged, but the standard *error* on the catch rate *coefficient* increased resulting in a t-statistic of about 1.3.

The coefficient estimates all have intuitively correct signs, and they are different from zero at better than the 5 percent significance level Having an " inboard motorboat seems to induce more striped bass tripa than having an outboard motorboat. The own-price elasticity for Participant is about minus one, while the catch rata elasticity *for* participant is about .10,

Table 6.3

Tobit Estimation of the Demand for Striped Bass Fishing

Explanatory Variable	Coefficient Estimate	t-statistic	Mean of Variable
Constant (C)	-10.6	-5.79	1.00
Own price ('IT)	-.336	-7.52	$27.2
Catch rate (CR)	.337	2.13	3.2 fish/day
Inboard Motor (IB)	12.65	4.49	.10
Outboard Motor (OB)	6.66	3.47	.31
Budget (FHB)	1.40	3.04	. 70($000)

$\hat{\sigma}^2 = 18.3$
N = 760

We can use the estimated coefficients in Table 6.3 to estimate welfare effects of increases in catch rates. As in Chapters 4 and 5, two estimates of consumer surplus are provided. Method A employs predicted trips plus changes in predictions whereas Method B uses actual trips plus changes in predictions.

It is rather eaay to expand sample results to the population, since the Fish and Wildlife Survey includes sample weight or sample expansion factors. These weights account for the fact that different population strata are sampled disproportionately. Consumer's ● rplua for the population is simply the weighted sum of the surpluses of the sample observation:

(6.4) $$Cs = \sum_{1} \frac{-(x^1)^2}{2\beta_1} f_1$$

where s is the sample size and f_1 is the expansion factor.

Table 6.4 gives the estimates of aggregate surplus. The first column is the estimate of the value of access to striped baas fishing as it was perceived in 1880, baaed on 1980 prices. The actual and predicted estimates differ substantially, with the actual being more than three time. larger than the predicted.

Table 6.4

Aggregate Consumers' Surplus for Striped Bass Fishing:
Effect of Changing Catch Rates, 1960

(Population of Maryland Hunters and Fishermen)

	Aggregate Consumer Surplus for Access	Surplus Change with Change in Catch Rate	
		20% Decrease	10% Increase 20% Increase
	. . . . . Thousands of Dollars		
Predicted (Method A)	14,652	-572	314 1,501
Actual (Method B)	54,196	-422	231 4s1

The second, third and fourth columns in Table 6.4 give the net impact of a 20 percent reduction, 10 percent increase and 20 percent increase, respectively, in the striped baa. catch rate compared with the level perceived in 1960. Here the actual and predicted results are closer, especially for the 10 percent changes.

The numbers that are most interesting for environmental policy on the Chesapeake are found in the third and fourth columns. These figures are rough estimate. of the dollar amount people who currently fish or hunt in Maryland might gain annually from improving striped baas fishing.

There are a number of complicating factors which cannot be integrated into our preliminary calculations of benefit estimates. First, consider how long it would take for environmental policy to produce a ● ubdantid, sustainable increase in catch rate. Reduction in effluents for one year will have only a small effect. To improve ambient water quality enough to bring about better striped bass reproduction and survival could take many years.

The second question relates to the role of expectations regarding catch. Aaide from the likely bias and high noise in the catch rate estimate, what respondents report is the ox post realisation of catch rates, while their decisions regarding whether, when, and how frequently to go are baaed on expectation about the catch rate, ex ante. Consequently, while recalled ex post catch rate is the best quality variable we could obtain for striped baas

fishing, we need to be skeptical about its implications for the relationship between days taken and expected catch rate.

The second question concerning these benefit estimates is whether, given sufficiently improved ambient water quality, the catch rates are sustainable. The answer is no. Better catch rates induce more fishing and hence more harvest. Since there is some evidence that overharvesting is partly responsible for the decline in fish populations to begin with, it is likely that healthier stocks will induce more harvesting. The long run equilibrium will result in higher than current benefits, but smaller than the benefits which implicitly assume that the increase in fishing effort will have no long run effects on fish stocks.

Last, it is worth remembering that the benefit estimates are baaed on a sample of households that hunted or fished in Maryland in 1980. If there are people who currently do not hunt or fish, but would go striped bass fishing if the fishing improved sufficiently, then the annual benefit estimates are an underestimate.

chapter 7

Conclusions

Restoration of Chesapeake Bay water qulity rewires substantial resources on the part of public agencies, private firms and households. There are many choices to be made in implementing programs to clean up the Bay. This report haa described acme of the activities which would benefit from the enhancement *of* Bay water quality. Chapters 2 and 3 described ways in which people think about the Bay and benefit *from* better water quality. Chapters 4 through 6 contain descriptions of come recreational activities which would gain from improved water quality. All of these chapters provide estimated willingness to pay *from potential* improvements.

In deriving benefits, sometimes we 1000 eight *of* the informational content of the models behind the *benefit* estimates, the estimated demand functions themselves. Chapters 2 through 6 contain substantial new information about the structure of demand *for* recreational activities associated with the Chesapeake Bay. In nearly every instance where sufficient data were available, recreators responded to travel and time costs in a manner consistent with our theoretical model. They were also observed to be responsive to even the crudest of water quality measures. Additionally, demographic variables such as income, race, and boat ownership were observed to influence behavior. As we turn to the benefit estimates, the reader is reminded not to consider the "bottom-he" benefit figures as the only value of this report.

Demand *for* Chesapeake Bay Recreational Activities

The data and modelling exercises described in Chapters 3 through 6 provide a good picture *of* the recreational use of the Chesapeake Bay. Chapter 3 includes an overall picture of Chesapeake recreational activities derived from a random sample of all households in the Baltimore/Washington SMSA's (BWSMSA). This survey revealed that a full 43 percent of the BWSMSA population used the Bay or intended to use it for recreation in 19S4. Geographical distribution of users showed *Anne* Arundel County reaidenta (69 percent) moat likely to be Bay users and District of Columbia residents (21 percent) to be least likely (ace Table 3.1). The moat common recreational activities were fishing, swimming and boating, with about a third of the Bay users participating *in* all three activities. Of these activities, swimming was enjoyed by more people than either of the other two, with 77 percent of users participating. In the remaining chapters, each of these activities was looked at in greater detail using specific surveys of subsamples of the population.

In Chaptar 4, wa provide two types of demand models *for* western shore beach uae activity. Each draw. on an on-site sample *of* beach users at western shore beaches in the summer of 19S4. The varying parameter model is a modification of traditional demand models where the demands for tripe to each cite are treated largely independently, but the difference in parameters across sites are attributed in part to site characteristic. The discrete choice model explains the choice among cites directly, as a function of site characteristics, but does not handle the total number of trips well. Each type *of* model gives a good description of one aspect *of* the recreational decision.

From the results in Chapter 4 it is char that both money and time access costs are extremely important in determining demand *for* trips to any given beach, as are the costs of accessing alternative beaches. Whether or not an individual owns a boat or recreational vehicle also affects demand *for a* subset of beaches, those which have facilities for these capital goods. Demand functions for trips to a site tend to pivot inward, becoming more elastic, with declining water quality.

The results of the nested multinominal logit or discrete choice model of beach use suggested acme similar and acme additional characteristics of demand for this activity. Once again, money and time costs of access were important this time in explaining the choice among sites. Additionally, the availability of boating and recreational vehicle facilities increased the likelihood of a boat or recreational vehicle owner to choose a site. An *interesting* hypothesis was tested regarding the differential substitutability among local beaches and among state beaches vis-à-vis the substitutability between local and state beaches. Beach users seemed to consider local beaches closer substitutes for one another than for state beaches. Individual with larger parties or families were more likely to attend state beaches where a variety *of activities* were available. The longer an individual had attended western shore beaches, the more likely he was to use local rather than state beaches.

Chapter 5 provides a rather extensive profile of boaters and boat owners derived from a survey of boaters sponsored by Maryland Sea Grant and Maryland Coastal Zone Management and from the BWSMSA telephone survey. The boater survey subsample includes registered boat owners in Maryland. The profile includes an analysis of characteristics which distinguish boat owners from others and looks at these distinguishing characteristics b y geographical area. Average household income, for example, is higher for boat owners than non-owners, but this difference is only ● tatiatically significant in *Prince* Georges, Anne Arundel and Calvert counties.

Considering the boats themselves, a different profile characterizes those which are kept in the water all season (in marinas, moored, etc.) than characterizes boats which are trailered. As would be expected, trailered boats are significantly smaller and less valuable, they are more likely to be runabouts or workboats and their owners are likely to have less income than the owners of boats kept in the water. Almost all trailered boats were used for *fishing* at least Occasionally. About three-quarters of the non-trailered boats were used for swimming at least Occasionally.

Table 5.4 summarizes the boat owners survey by county of residence, revealing *more* about the geographical distribution of Bay users. Residents of Baltimore and Anne Arundel counties accounted for 39 pecent of the trailered boats and 45 percent of the non-trailered boats with Prince Georges County and Montgomery County residents accounting for another 20 percent *of* trailered and 12 percent of non-trailered boats.

The last of the descriptive information suggests the importance of water quality to boaters. Water quality was considered either moderately or *very* important in the selection of a boating area by 75 percent of the trailered boat owners and by 76 percent *of* the non-trailered boat owners,

A varying parameters model similar to the one used in Chapter 4 revealed that trailered boat owners' demand for trips from launch sites was affected by access costs to the launch site and costs of accessing alternative sites. In general, the demand for trips to any given site was positively affected by the value of the boat; i.e., individuals with more valuable boats took more trips. The demand function for any given site tended to pivot inward and become more elastic as water quality declined.

Owners of boats kept in the water do not choose launch sites when they take a trip, and consequently we have no way of knowing where they boat. As a result we cannot model their decisions in responnse to varying water quality. For these individuals? simple demand functions were estimated. Factors which significantly affected their demand for boating trip. included the coat of a trip (negatively) and the value of the boat (positively). Additionally it was determined that sailboat owners tend to take fewer trips and their demand for trips is more price inelastic. Finally, boat owners who fish while boating tend to demand more trips and their demand tend. to be more price elastic.

In Chapter 6 information about • portfishing on the Bay is presented. Estimates of sportfishing activity vary by data source and range from 539,000 to 900,000 anglers in 19S0 and from 2.7 million to 4.1 million trips for that came year. The two prominent sources of information on sportfishing are the U. S. Fish and Wildlife Hunting and Fishing Survey and the U. S. National Marine Fisheries Survey.

Our analysis in this chapter concentrated on ● tripod bass fishing since this was the only species important to Chesapeake recreational fishing for which ● ufflciently detailed data existed. One source (U. S. Fish and Wildlife) reports that in 1960, 239,000 anglers fished for striped bass in Maryland and Sussex County, Delaware and fished 2.1 million days in total. Table 6.1 presents come descriptive statistics of striped bass fishermen and other Chesapeake Bay fishermen.

In the analytical section of Chapter 6, demand for sportfishing trips was modelled as a function of the individual'. trip costs, catch rates, his annual fishing/hunting budget and indices of types of boat ownership. All variables affected the demand for trip. in the expected direction, with owners of inboard motorboat likely to take more trips than those with outboard (presumably smaller) motorboat.

1?— of Benefits from Water Quality Improvements

While the analysis of the demand for recreational activities is worthwhile in ita own right, more information about the size of rewards from Bay restoration can be obtained, There are several reasons for computing aggregate willingness to pay rather than simply providing descriptive measures such as recreational use days. Obviously such measures cannot be compared to the costs of restoration; they cannot even be added across activities. A day of fishing is different from a day of swimming, and changes in water quality have different effects on the benefits derived from the two activities. Further, as we observed in Chapter 3, there is some willingness to pay for clean water by people who do not use the Bay. If we limit ourselves to descriptive measures such as user days, we ignore the returns to people

who value cleaner water but do not uae it. Consequently, we have taken a first step toward the logical, albeit venturesome, task of estimating the aggregate benefits of improving the Bay's water quality.

Caveats

The aggregation of benefits across activities and for the population at large is venturesome because it is so filled with known difficulties. We can take a systematic view *of* these potential errors by *recalling* the links between environmental policies designed to reduce effluent pollution and the benefits of environmental improvements. Policies influence effluents directly through regulations and indirectly through changes in incentives. Reductions in effluents will eventually improve the ambient water quality. Improvements in ambient quality when perceived by individuals eventually lead to changes in behavior toward the Bay, implying *benefits.* Further, when non-users perceive improvements in the ambient water quality, they too will be better *off.* There is potential for *errors in* the measurement of each link in this process.

The analysis of the previous chapters has concentrated on the connection between ambient quality and economic benefits. It rests, however, on the relationship between environmental policy, effluents, and ambient quality. The considerable debate regarding the connection between effluents and ambient quality suggests the potential for honest differences of opinion on the nature of the ecological links. Similar uncertainty over the behavioral and perception links exists.

While a complete catalog of the sources of potential error would take an entire chapter, we describe broadly what we think the *major* difficulties are. If the problems inherent in explaining the link between policy and ambient quality are ignored, the foremost uncertainty is between ambient quality and behavior. Recall briefly how this link waa estimated. For boating and beach uae we used a varying parameters model to estimate the relationship between the product of total phosphorus and nitrogen readings in 1977 and trips in 19S4. There is clearly substantial room *for* error in this relationship.

First, since people cannot perceive nitrogen and phosphorus, we must assume that the nitrogen and phosphorus are approximate measures of the ambient quality. It is not unreasonable to expect such a relationship to hold in principle. Chapter 2 describes ways in which individuals form perceptions of *water* quality. Some of the deductive and media-baaed means by which individuals form quality perceptions may be directly related to effluent discharges. Others, such as stimulants of sensory perceptions, may be highly correlated with, or even caused by, nitrogen and phosphorus levels. Previous studies which have attempted to link behavior to individual ambient water quality indicator. (e.g. Binckley and Hanemann) have detected a correspondence. Chapter 2 describes acme evidence which supports this, hypothesized link derived from our telephone survey of the BWSMSA and the field survey of western shore beaches. Through the telephone a significant relationship waa detected between a household perception of the water quality in the Bay and ita likelihood to quit using the Bay. Additionally, a *significant* relationship appeared between objective measures *of* the Bay's *water* quality over time and the proportion of households who atopped using the Bay for recreation because they perceived the Bay's water quality to be unacceptable. Finally, the user (field) *survey* showed *a* positive correlation between

meaaures of fecal coliform at each of nine beaches and the proportion of households that found each beach unacceptable.

A further difficulty is the seven years which separate the nitrogen/phosphorus readings and the recreational behavior, since 1977 was the latest year for which complete information was available. While this is clearly a source of potential error, there are a few reasons why it might not be as bad as it seems. For one thing, the relative levels across different regions *of* the Bay may have remained approximately constant even if absolute levels have changed. Additionally, it is not clear what year or combinations of years would be correct in signaling the recreational behavior stimulated by water quality because behavior is probably largely affected by prior experiences.

Since we are really explaining choices among sites *of* different quality, our behavioral models depend more on the relative levels of ambient water quality rather than on absolute levels; and if relative levels have remained fairly constant, our behavioral models are likely to be quite good. Extracting *benefit* measures *from* these models, however, must be done with caution since the absolute levels of nitrogen and phosphorus readings used may not be trustworthy y.

For recreational fishing the problem is in some waya a little simpler. Here we use the catch rate experienced by the individual for 1980, the year the trips were *taken.* There is of course a complex and uncertain chain of relationships between improvements in ambient quality and growth in the density of fish stocks. There is *further* uncertainty in the connection between fish stocks and catch rates. These are largely, although not completely, problems of biology and are not addressed here, but nonetheless remain as imperfectly understood links in the system.

Restricting our comments entirely to the behavioral realm does not eliminate these uncertainties and potential sources of modelling error. In what sense is the catch rate in the year the trip. *were* taken a good measure *of* quality? Fishermen may value higher catch rates but their demand (behavior) *for* tripa this year may be baaed on catch rates experienced in previous years. When the quality of the good is uncertain to the consumer, there may be one eat of quality indicators that stimulate demand and another which affect the benefits derived from consumption. Further, there is no guarantee that catch rate is the only (or moat important) variable which determines the enjoyment of trips to catch fish. For example, catching one five-pound striped baaa may be batter than catching two two-pound stripers.

In addition to the severe difficulties in inferring the relationships between ambient quality, there are two other significant sources of error in computing aggregate benefits. First, there is the problem of sampling and non-sampling error associated with the measurement of the number of trips per participant and the number of participant in each activity, м well as measurements of exogenous variables such as costs per trip. The boating survey is a good example of non-sampling error *for* trips This survey waa a mail survey, so in a sense the respondents are volunteers. The return rate was 70 percent. We have no way of knowing whether those who competed their questionnaire. were representative of the boating population as a whole or if there is a built-in sample selection bias.

We have also used only segments of the total population in our analysis of benefits. The boaters were limited to those who trailer their boats, the fishermen to those who fish for striped bass and the beach users to those who use public-accees western shore beaches. In the boating and fishing analysis we have excluded non-Maryland households. In the contingent valuation and beach uae analysis, only 20 percent *of* Virginia's population wae included and about 80 percent *of* Maryland's households. In every instance, a major portion of users is excluded so any estimates derived will be lower bounda.

Another source of error in aggregating benefits across activities is aggregation bias. This comes in two forms: simple doublecounting and conceptual aggregation bias. Doublecounting occurs because a ● ubatantial number *of* boaters also fish, and many fishermen have boats. The conceptual aggregation biaa occurs because of the jointness of choice among sites for a given activity and among activities. For example, the choice of visiting Sandy Point versus Point Lookout may depend in part on water quality. Enhancing water quality at both sites may only increase attendance at one sites making the addition of benefits across sites incorrect. A discussion of this problem is *offered in* Chapter 3, but both forms of aggregation bias are treated in detail in Chapter 5 of the conceptual volume of this report.

Finally, we must remember that we have only three activities: boating, fishing, and swimming. There are many other recreational and commercial uses of the Bay whose value is enhanced by cleaner water. For example, our analysis of fishing *rovers* only striped bass; fishing for species besides striped bass (e.g. crabbing) is widespread and not covered by our analysis. And our analysis *of* the effect of changes in water quality covers *only* trailered boats, not boats at marinas. Many other, especially more casual, activities are omitted. We have limited our analysis to boating, fishing, and swimming because we could obtain data of adequate quality only for these activities

Estimates

With these difficulties firmly in mind, we are prepared to hazard some judgments *on* the magnitude of the aggregate benefits of improving the Bay's *water* quality. Cur approach is to present low, middle and high benefits for the beach use (Chapter 4), boating (Chapter 5), and fishing (Chapter 6) and qualitatively compare those benefits with the total benefits derived from Chapter 3. Comparing the ranges of these independent sources *of* benefits will help us to form a judgment, but nothing *more,* of the magnitude of aggregate benefits.

Chapters 4 through 6 give *benefit* estimates for activities conditioned on the computational method and the proportionate change in ambient quality and catch *rate.* We adopt the convention of analyzing a 20 percent reduction in nitrogen and phosphorus for boating and beach use and a 20 percent increase in the catch rata for striped bass fishing. These changes should be interpreted loosely as considerable improvements in the quality of the Bay without attaching much significance to the absolute change in ambient readings which would be implied. In particular, one should not interpret the estimated effect of nitrogen and phosphorus as an "all else equal" effect. The change in nitrogen and phosphorus is a proxy for changes in moat ambient

determinants of water quality so that the implicit assumption is that a range of ambient factors may be improving. Further, to counteract the problem of aggregating across sites for a given activity, we select as a pessimistic estimate the lowest estimate of the benefits of improving the quality by 20 percent at the one most important site.

Table 7.1 summarizes some of the estimates of aggregate benefits for our groups of boaters, sportfishermen and beach users, translated into 1987 dollars. The variation from pessimistic to optimistic is provided by two sources: variation induced by the method of calculating benefits (i.e., using actual trips versus predicted trips) and variation caused by choosing one site rather than the sum over all sites. Recall that because each site's benefits are calculated assuming other sites' quality remains unchanged aggregating these measures over sites will produce an upwardly biased aggregate benefit. The pessimistic estimates for beach use and for boating are the lower of the two estimates of the benefits for a 20 percent improvement in water quality from Sandy Point for beach uae and Anne Arundel County for boating. One site was chosen as a lower bound because wtth only one site all (upward) aggregation bias is eliminated. The average estimates for beach use and boating are the lower of the two calculation methods for sums across all sites. The optimistic estimates are the higher of the two calculation methods for the sums across all sites. For striped bass fishing, the pessimistic estimate is the lower of the two methods of calculation. The sites have already been aggregated for the fishing case, and as we show in Chapter 5 of the accompanying volume, the nature of the aggregation bias in this case is not obvious. The optimistic estimate is the higher of the two calculation arithmetic methods and the average is the mean of the pessimistic and optimistic.

Table 7.1
Aggregate Benefits for Three Water-related Activities from a "20%" Improvement in the Chesapeake Bay's Water Quality in 1967 dollars

Activity	Benefit Estimate		
	Pessimistic	"Average"	(Mimistic
		($ Thousand)	
Public Western Shore Beach Use[a]	16,853	34,658	44,960
Boating with Trailered Boat[b]	664	4,717	8,129
Striped Bass Sportfishing[c]	664	1,366	2,071

● From Table 4.6. Pessimistic estimate is the Method B value for Sandy Point, the average is the sum of Method B values over all ten sites, and the optimistic is the sum of Method A values over all sites.

[b] From Table 5.13. All per boater estimates expanded to 60,000 boaters " trailering boats. Pessimistic estimate is the low value (Method A) for Anne Arundel County, the average estimate in the sum of low values (Method A) across all counties and the optimistic value is the sum of high values (Method B) across all counties.

[c] From Table 6.4. Pessimistic value is the value using Method B, the "average" value is the average of the pessimistic and optimistic value, the optimistic value is the value using Method A.

The aggregate meaaurea of willingness to pay *for* water quality improvements are revealing for several reasons. First, regardless of which benefit measure we use (pessimistic, average, or optimistic), the returns to beach use are the greatest. This ia primarily because a larger proportion of the population engages in come beach-going during the year than boating Or fishing. Additionally, this group may be more sensitive to changes in water quality than the boating-fishing group.

A second interesting implication *of* the results, although not obvious from looking at Table 7.1, is the importance of regional variation in water quality. If we *were* able to clean up the water around Anne Arundel County only, we would still go a long way towards satisfying some of the human needs for using the Bay. While we realize that confining a water qualtty improvement program to a particular locality may not be technically or ecological y feasible, any clean-up strategies which result in significant improvements in this region *of* the Bay will yield substantial benefits.

A comparison *of* the behaviorally based measures of benefits presented in Table 7.1 with benefit estimates derived from contingent valuation (ace Table 7.2) is interesting even though the valuation questions driving the two analyses are different. All of the estimates in Table 7,1 are partial estimates in that they account for only one activity and involve only ● ubaeta of the population. Table 7.2 presents contingent valuation produced benefit estimates associated with a broader but less precise hypothetical improvement: improving water quality to an "acceptable" level. The subset *of the* population includes those *in* the BWSMSA who found water quality unacceptable for swimming or related uses.

Table 7.2

Aggregate[a] Benefits from Water Quality Improvements-
Contingent Valuation
in 1984 dollars

Group	Willingness to Pay for Improved Water Quality[b]		
	Pessimistic[c]	Average[c]	Optimistic[c]
	($ Thousand)		
User	47,254	67,582	87,870
Non-User	18,446	23.556	28.733
Total	65,700	91,137	116,603

[a] Population is the Washington, D. C. and Baltimore SMSA's

[b] Willingness to acceept tax increase to raise Chesapeake Bay Water quality from a level unacceptable for swimming end/or other related activities to a level acceptable for swimming.

[c] The average willingness to pay plus or minus one standard error in est imate. See Table 3.8.

The numbers in Tables 701 and 7.2 give likely magnitudes for the annual benefits *of* improving water quality in the Bay. The numbers suggest a range of from $10 million to over $100 million, We know that there are numerous random elements in all estimates. Further, we know that several activities and populations have been omitted. But based on these numbers, it seems plausible to estimate that the annual returns to cleaning up the Chesapeake are at least of this order of magnitude. We have only the evidence presented herein to make this judgment.

In conclusion, we recapitulate the premise. Society haa undertaken an investment program. The nature of the program is the cleanup *of* the Chesapeake Bay. The costs of the program include such things as sewage treatment plants, funding of government programs to regulate and monitor agricultural effluents, installation of industrial waste disposal systems, restrictions on housing development, etc. The annual returns on the investment program are measured by what people are willing to pay for the improved services of the Bay. TMa is the dividend yielded by the public's investment program.

For several reasons, we think that the long-run benefits are higher than the figures Tables 7.1 and 7.2 indicate. First, as people learn that the Bay haa become clamor, they will adjust their preferences toward Bay recreation. This is especially true of people who do not currently use the Bay and are largely excluded from the analyaia. Second, the population and income of the area have grown since 1984, and both are likely to grow more, increasing the demand for and value *of* improvements in water quality. Finally, we have ignored the value (both uae and existence value) which households outaide the BWSMSA may have for the Bay. The Chesapeake Bay is a nationally prominent resource. Its improved health is of value to many who will never use it.

REFERENCES

Bell, F. W. 1968. "The Pope and the Price of Fish." *American* Economic Review 58142-147.

Binkley, Clark S. and W. Michael Hanemann. 1978. The Recreation Benefits *of* Water Quality Improvements: An Analysis *of* Day Trips in an Urban Setting. Washington, D.C. E. P.A.-600/5-78-010.

Bishop, R.C. and T.A. Heberlein. "Simulated Markets, Hypothetical Markets and Travel Cost Analysis: Alternative Method. of Estimating Outdoor Recreation Demand." Working paper no. 187.

Bishop, R. C. and K. Sample. 1886. "Estimating the Value of Variations in Anglers' Success Rate.: An Application of the Multiple-Site Travel Cost Method." Marine Resource Economics 2:1:55-74

Blackburn, A.J. 1870. "An Alternative Approach to Aggregation and Estimation in the Non-Linear Model." Ch. 9 in The Damand for Travel: Theory and Measurement. Edited by R. E. Quandt. D.C. Heath, Lexington.

Bockstael, Nancy, W. Michael Hanemann and Catherine Kling. 1887. "Modeling Recreational Demand in a Multiple Site Framework." Water Resources Research. Forthcoming.

Bockstael, Nancy, W. Michael Banemann and Ivar Strand. 18SS. Measuring the Benefits of Water Quality Improvments Using Recreation Demand Models. Report presented to the B.P.A. under Cooperative Agreement CR-81 143-01-1, Volume II.

Bockstael, N. E., and K. E. McConnell. 1981. "Theory and Estimation of the Household Production Function for Wildlife Recreation." Journal *of* Environmental Economics and Managemont 8:188-214.

Bockstael, N. E., and K. E. McConnell. 1983. "Welfare Measurement in the Household Production Framework." American Economic Review 73:806-814.

Bockstael, N. B., and J. J. Opaluch. 1983. "Discrete Modelling of Supply Response under Uncertainty: The Case of the Fishery." Journal of Environmental Economics and Management 10:125-137.

Bockstael, N. B., I. B. Strand, and W. M. Hanemann. 1987. "Time and The Recreational Demand Model." American Journal of Agricultural Economics 69213-302

Bockstael, N. E. and I. E. Strand. 1987. "The Effect of Common Sources of Regression Error on Benefit Estimates." Land Economics 63:11-20.

Bockstael, N. E., I. E. Strand, and A. Graefe. Economic Analysis of Artificial Reefs: A Pilot Study of Selected Valuation Methodologies. Technical Report #6. Artificial Reef Development Center, Sportfishing Institute. 1986.

Brookshire, D.S., L.S. Eubanks and A. Randall. . 1983. "Estimating Option Prices and Existing Values for Wildlife Resources. " Land Economics 58:1-15.

Brown, Gard nor and Robert Mendelsohn. 1984. "The Hedonic Travel Cost Method." Review of Economics and Statistics 66:427-33.

Brown, W. G., C. Sorhus, B. Chow-Yang, S. Richards. 1883. "Using Individual Observations to Estimate Recreation Demand Functions." " American Journal of Agricultural Economics 65:154-157.

Brown, W. G., C. N. Sorhus, and D. A. Meyer. 1882. "Estimation of *Oregon* Sport-Caught Salmon and Steelhead Values Via the Travel Cost Method." Mimeo, ASSA Meetings, 25 ppa.

Brown, W. G., A. Singh and E. N. Castle. "Net Economic Value *of the* Oregon Salmon-Steelhead Sport Fishery." Journal of Wildlife Management 29(2):266-279.

Burt, Oscar and Durward Brewer. 1872. "Estimation of Net Social Benefits From Outdoor Recreation." Econometrica 39:813.

Carson, R. T. and *R C.* Mitchell 188s0 "The Value of Clean Water: The Public'. Willingness to Pay *for* Beatable, Fishable, and Swimmable Quality Water." Discussion paper No. QE85-08 revised, (Washington, D. C., Resources for the Future).

Castle, Emery N. and W. G. Brown. 1884. "The Economic Value of a Recreational Resource: *A* Case Study of the Oregon Salmon-Steelhead Sport Fishery. Paper presented before the Committee on the Economics *of* Water Resource* Development of the Western Agricultural Economics Research Council, San Francisco, California.

Caulkins, Peter, Richard Bishop and Nicolass Bouwes. 1982. "The Travel Coat Model for Lake Recreation A Comparison of Two Methods *for* Incorporating Site Quality and Substitution Effects." Mimeo, ABA annual meetings,

Caulkins, Peter P., Richard C. Bishop and Nicolass W. Bouwes, Sr. 1888. "The Travel Cost Model for Lake Recreation: A Comparison of Two Methods for Incorporating Site Quality and Substitution Effects." Amer. J. Air. Econ. 68(2):291-297.

Caulkins, Peter, Richard Bishop and Nicolass Bouwes. 1985. "Omitted Cross-Price Variable Biases in the Linear Travel Coat Model: Correcting Common Misperceptions. " Land Economics 61:182-85.

&aario, Frank J. 1969. "Operations Research in Outdoor Recreation." Journal of Leisure Research 1:33-52.

Cesario, Frank J. 1973. "A Generalized Trip Distribution Model." Journal of Regional Science 13:233-48.

Cesario, Frank J. 1974. "More on the Generalized Trip Distribution Model," Journal of Regional Science 14:389-97

Cesario, Frank J. and Jack Knetach. 1976. "A Recreation Site Demand and Benefit Estimation Model." Regional Studies 10:97-104.

Christensen, L. R., Jorgenson, D.W. and Lawrence Lau. 1975. "Transcendental Logarithmic Utility Functions." American Economic Review 65:367-83.

Cicchetti, Charles, Anthony Fisher and V. Kerry Smith. 1976. "An Econometric Evaluation of a Generalized Consumer Surplus Measure: The Mineral King Controversy." Econometrica 44:1268-76.

Cicchetti, C.J., J.J. Seneca and Paul Davidson. 1869. The Demand and Supply of Outdoor Recreation: An Econometric Analysis. Rutgers. 1869.

Clawson, MartOn. 1859. Methods for Measuring the Demand for and Value of Outdoor Recreation. Resources for the Future, Inc., Reprint no. 10.

Clawson, Marion and Jaok Knetach. 1866. Economics of Outdoor Recreation. Resources for the Future, Washington D.C.

Cox, D.R. 1861. "Tests of Separate Families of Hypotheses." Proceedings of the Fourth Berkeley Symposiurn on Mathematical Statistics and Probability, Vol 1. University of California Press.

Cronin, F. J. 1882. "Valuing Non-Market Goods Through Contingent Markets." Rep. PNL-4255, Pac. Northw. Lab., Richland, Wash.

Cropper, M. L., L.B. Deck, K.B. McConnell and T.T. Phipps. 1886. "Should the Rosen Model be Used to Value Environmental Amenities?" Papar presented at the conference on the Economics of Chesapeake Bay Management 11, Annapolis, MD.

Cummings, R G., D. S. Brookshire and W. D. Schulze. 1984. valuing Environmental Goods: A State of the Arts Assessment of the Contingent Valuation Method. Draft report to EPA. Universities of New Mexico and Wyoming. "

Daubert, J. T. and R A. Young. 1981. "Recreational Demands for Maintaining Instream Flows: A Contingent Vaulation Approach." Amer. J. Agr. Econ. 63(4):666-676.

Deaton, A.S. 1974, "The Analysis of Consumer Demand in the United Kingdom, 1800-1970." Econometrics 42:341-67.

Deaton, Henry. 1978. "Specification and Testing in Applied Demand Analysis." Economic Journal 88:524-36.

Desvousges, W. H., V. K. Smith and M. P. McGivney. 1983. A Comparison of Alternative Approaches for Estimation of Recreation and *Related* Benefits *of* Water Quality Improvements. Washington, D. C.: Environmental Protection Agency, Office of Policy Analysis.

Deuel, D. G. 1978. "National Marine Recreational Fishery Statistics Program." Paper presented at Canadian Sport Fisheries Conference, New Brunswick, Canada.

Domencich, Thomas and Daniel McFadden. 1975. Urban Travel Demand: A Behavioral Analysis. North-Holland, Amsterdam.

Dwyer, J. F. and M. D. Bowes. 1978. "Concepts of Value for Marine Recreational Fishing." American Journal of Agricultural Economics 60(5): 1008-10120

Feenberg, Daniel and Edwin Mills. 1980. Measuring the Benefits of Water Pollution Abatement. New York, Academic Press.

Fisher, Ann and William H. Desvousges. 1881. "Alternative Contingent Market Approaches to Valuation of Recreation and Related Benefits of Improved Water Quality." Paper presented at the Eastern Economics Association Meetings, Washington D.C.

Fisher, Am and Robert Raucher. 1982. "Comparison of Alternative Methods of Evaluating the Intrinsic Benefits of Improved Water Qualiy." Paper presented at ASSA meetings, New York City.

Fisher, F. and K. Shell. 1871. "Taste and Quality Change in the Pure Theory *of* the True Cost-of-Living Index." in Price Indexes and Quality Change. Edited by Zvi Griliches. Harvard University Press, Massachusetts.

Freeman, A. Myrick III. 1979. The Benefits of Environmental Improvement: Theory and Practice. Johns Hopkins Press for Resources for the Future, Inc., Baltimore. 1979.

Freeman, A. Myrick III. 1882. Air and Water Pollution Control: A Benefit-Coat Assessment. John Wiley and Sons.

Freund, R. J. and R. R. Wilson. 1974. "*An* Example of a Gravity Model to Estimate Recreation Travel." Journal of Leisure Research 6:241-56.

German, W.M. 1976. "Tricks with Utility Function." in Essays in Econmic Analysis: Proceddings of the 1975 AUTE *Conference*, Sheffeld. Edited by M.J. Artis and A.R. Nobay. Cambridge University Press, Cambridge.

Greenley, Douglas A., Richard G. Walsh and Robert A. Young. 1981. "Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality." Quartelv J. Econ. 96(4):657-673.

Gum, R.L. and W.E. Martin. 1975. "Problems and Solutions in Estimating the Demand for and Value of Rural Outdoor Recreation." American Journal of Agricultural Economics 57:558-66.

Hanemann, W. Michael. 1980. "Quality Changes, Consumer's Surplus, and Hedonic Price Indices." California Experiment Station working paper number 116.

Hanemann, W. Michael. 1981. "Quality and Demand Analysis." Ch. 3 in New Directions in Econometric Modeling and Forecasting in U.S. Agriculture. Edited by Gordon Rausser, Elsevier/North-Holland, New York.

Hanemann, W. Michael. 1882. "Applied Welfare Analysis with Qualitative Response Models." California Agricultural Experiment Station working paper no. 241.

Hanemann, W. Michael. 1984a. "Multiple Site Demand: A Review of Existing Models and New Development", Chapter 9 in Measuring the Benefits of Water Quality Improvements Using Recreation Demand Models. Draft Report presented to E.P.A. under Cooperative Agreement CR-80043-01-0, VOL II.

Hanemann, W. Michael. 1984b. "Discrete/Continuous Models of Consumer Demand." Econometrics 52:541-61.

Hanemann, W. M. 1978. "A Methodological and Empirical Study of Recreation Benefits from Water Quality Improvement." Ph. D. dissertation, Department of Economics, Harvard University.

Hanemann, W. M. 1984. "Welfare Evaluations with Market Data." American Journal of Agricultural Economics. 66:332-41.

Hanemann, W. M. 1984. "Welfare Evaluation in Contingent Valuation Experiment with Discrete Responses." American Journal of Agricultural Economics. VOL 66(3):332-341.

Harmon, R. J. and Associates. 1883. Recreational Resources at Risk. Taak 2 Working Paper. Washington, DC.

Harrison, D. and D. Rubinfeld. 1878. "Hedonic Housing Prices and the Demand for Clean Air." Journal of Environmental Economics and Management 5:81-102.

Hausman, J.A. 1886. "Exact Consumer's Surplus and Deadweight Loss." American Economic Review 71:662-76.

Heintz, H.T. Jr., A. Hershaft and G.C. Horak. 1976. National Damages of Air and Water Pollution. A Report to the EPA. Enviro Control, Inc. Rockville, MD.

Hiett, R. L. and J. W. Worrall. 1977. "Marine Recreational Fisheries Ability to Estimate Catch and to Recall Catch and Effort over Time." Human Sciences Research, Inc., Report HSR-RR-77/18, Washington, D.C.

Horowitz, Joel. 1983. "Statistical Comparison of Non-nested Probabilistic Discrete Choice Models." Transportation Science 17:319-50.

Hotelling, H. 1948. Letter to the National Park Service in "Economics of Outdoor Recreation" - The Prewitt Report.

Huppert, D.D. 1983. NMFS Guideline. on Economic Valuation of Marine Recreational Fishing. NOAA Technical Memorandum NOAA-TM-NMFS-SWFC-32, Department of Commerce, Washington, D.C.

Johnston, J. 1972. Econometric Methods. Second Edition McGraw-Hill, New York.

Just, Richard, Darrell Hueth and Andrew Schmits. 1982. Applied Welfare Economics and Public Policy. Englewood Cliffs, N.J. Prentice-Hall Inc.

Just, R E., and D. L. Hueth. 1979. "Multimarket Welfare Measurement." American *Economic Review* *69947-64.*

Kealy, Mary Jo, and Richard C. Bishop. 1983. "Theoretical and Empirical Specification Issues in Travel Cost Demand Studies." Unpublished.

Kendall, M. and Alan Stuart. 1977. The Advanced Theory of Statistics. 4th Edition, (Vol. 1), New York: MacMillan.

Kling, Catherine. 1986. 'A Simulation Approach to Comparing Multiple Site Recreation Demand Model. Using Chesapeake Bay Survey Data." Paper presented at the Conference *on the Economics of* the Chesapeake Bay Management II, Annapolis, MD.

Kling, Catherine, Nancy Bockstael and Ivar Strand. 1985. "An Evaluation of Multiple Site Model Development." Paper presented at the *AEA* meetings, New York, N.Y.

Kling, Catherine. 1886. **Measuring the Recreational Benefits of Environmental Amenities Using Multiple Site Models: An Evaluation of Techniques.** Ph.D. Dissertation, University of Maryland.

Krutilla, J. V. 1967. "Conservation Revisited." American Economic Review. 57(Sept.):777-86

Lewbel, Arthur. 1975. "A Unified Approach to Incorporating Demographic or Other Effects into Demand Systems." Review *of* Economic Studies 42.

Loomis, J. 1986. "An Examination of the Variation in Empirical Estimates of Site Specific Marginal Values *for* Recreational Fishermen." Working paper, Division of Environmental Studies, University of California, Davis.

Maddala, G. S. 1983. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press New *York*.

Maddala, G. S. 1977. Econometric McGraw-Hill, Inc., N. Y. 516 pp.

Maler, Karl-Goran. 1974. Environmental Economics: A Theoretical Inquiry, Baltimore, Johns Hopkins University Press for Resources for the Future.

Mathews, S. B. and G. S. Brown. 1970. "Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington*" Washington Department of Fisheries, Technical Report #2.

McConnell, K. E. and N. E. Bockstael. 1984. "Aggregation in Recreation Economics: Issues of Estimation and Benefit Measurement." Northeastern Journal of Agricultural and Resource Economics 13:181-186.

McConnell, *K. E.* and I. E. Strand. 1981. 'Measuring the Cost of Time in Recreation Demand Analysis." American Journal of Agricultural Economics 63(Feb):153-156.

McConnell, K. B. 1986. Identification of *preference. in* Hedonic Models. Report presented to Environmental Protection Agency under Cooperative Agreement CR-811043-01-0, Vol I.

McConnell, K. E. 1879. "Values of Marine Recreational Fishing: Measurement and Impact of Measurement." American Journal of Agricultural Economics 61(5):921-923.

McConnell, K. E. and T. P. Smith. 1979. "Marine Recreational Fishing in Rhode Island," University of Rhode Island Marine Memorandum #62.

McFadden, Daniel. 1874. "Conditional Logit Analysis of Qualitative Choice Behavior." in Frontiers in Econometrics. Edited by P. Zarembka.

McFadden, D. 1978. "Modelling the Choice of Residential Location. " In Karlquist, Lundquist, Snickars, and Weibull (eds) Spatial Interaction Theory and Planning Models. New York North-Holland Publishing company.

Mendelsohn, Robert. 1984. "Estimating the Structural Equations of Implicit Markets and Household Production Functions." Review of Economics and Statistics 66:673-77.

Meyer, P. A. 1982. Net Economic Values for Salmon and Steelhead from the Columbia River Sustem. NOM Technical Memorandum NMFS F/NWR-3, U. S. Department *of* Commerce, Washington, D.C.

Miller, Jon. 1982. "Valuation Methods for Fish and Wildlife Associated Recreation: An Empirical Comparison of the Travel Coat and Contingent Valuation Method-." Paper presented at the ASSA meetings, New York, N.Y.

Mitchell, R C. and Richard T. Carson. 1984. "National Fresh Water Quality Benefits: Findings from a New National Contingent Valuation Survey." Presented at the annual AERE meeting, Cornell University.

Morey, Edward. 1981. "The Demand for Site-Specific Recreational Activities: A Charactaristics Approach." Journal of Environmental Economics and Management 8:345-71.

Morey, Edward. 1984a. "Characteristics, Consumer Surplus and New Activities: A Proposed Ski Area." Paper presented at the ASSA meetings, Dallas, TX.

Morey, Edward. 1984b. "The Choice of Ski Areas: Estimation of a Generalized CBS Preference Ordering with Characteristics." Review of Economics and Statistics 66:584-90.

Muellbauer, J. "Household Composition, Engel Curvea and Welfare Comparisons Between Households A Duality Approach." European Economic Review 5(1974):103-22.

Norton, V. J., T. P. Smith, and I. E. Strand. 1889. Stripers: The Economic Value of the Atlantic Coast Commercial and Recreational Striped Bass Fisheries. Maryland Sea Grant Publication #UM-SG-TS-83-12.

Pacific Fisheries Management Council. 1886. Review of 1985 Ocean Salmon Fisheries. Portland, Oregon.

Parks, RS. 1969, "Systems of Demand Equations: An Empirical Comparison of Alternative Functional Forma." Econometrics 37:629-65

Pesaran, M.H. and A.S. Deaton. 1978. "Testing Non-nested Non-linear Regression Models." Econometricca 46:677-94.

Pindyck, Robert and Daniel Rubinfeld. 1981. Econometric Models and Economic Forecasts. New York, McGraw-Hill Book Company.

Pow, Robert. 1971. "Additive Utility Functions and Linear Engel Curves." Review of Economic Studies 38401-14.

Pollak, Robert and Terence Wales. 19790 "Estimation of the Linear Expenditure System." Econometrics 37:611-29.

Pollak, Robert and Terence Wales. 1881. "Demographic Variables in Demand Analysis." Econometrics 4*1533-51.

Reiling, S. D., K.C. Gibbs and H.H. Stoevner. 1973. Economic Benefits from an Improvement in Water Quality, Washington,D.C., U.S. EPA.

Ribaudo, Marc O. and Donald J. Epp. 1983. "The Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality." Paper presented at the annual AAEA meeting, Purdue, Indiana.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." Journal of Political Economy 82:34-55.

Rowe, Robert, Edward Morey, Arthur Ross and W. Douglass Shaw. 1985. Valuing Marine Recreation Fishing on the Pacific Coast. Energy and Resurce Consultants, Report prepared for National Marine Fisheries Service, NOAA.

Russell, C. S., and W. A. Vaughan. 1982. "The National Recreational Fishing Benefits of Water Pollution Control." Journal of Environmental Economics and Management 9:328-354.

Samples, K. C., and R. C. Bishop. (Undated). "Estimating Social Value. of Sport Caught Fish A Suggested Approach." Draft, 12 pps.

Samuelson, Paul A. 1947. "Some Implications of Linearity," Review of Economic Studies 15:88-90.

Saxonhouse, G.R. 1977. "Regressions from Samples Having Different Characteri-tics." Review of Economics and Statistics 59294-7.

Schulse, W. D., D. S. Brookshire, B. G. Walther, M. K. McFarland, M. A. Thayer, R. L. Whitworth, S. Ben-David, W. Maim, and J. Molenar. 19S3. "The Economic Benefits of Preserving Visibility in the National Parklands of the southwest." Natural Resources Journal 23:149-173.

Sellar, Christine, John Stoll and Jean-Paul Chavas. 196s. "Validation of Empirical Measures of Welfare Change: A Comparison of Nonmarket Techniques." Land Economics 61:156-75.

Sellar, C., J. P. Chavas and J. R. Stoll. 1966. "Specification of the Logit Model: The Case of Valuation of Nonmarket Goods." Journal 'of Environmental Economics and Managment Vol. 13:382-390.

Smith, V. Kerry and William H. Deavousge. 1985. "The Generalized Travel Cost Model and Water Quality Benefits: A Reconsideration." Southern Economic Journal 62371-81.

Smith, V. K., W. H. Desvousges and Ann Fisher. 1986. "A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits." Amer. J. Agr. Econ. 68(2):280-290.

Smith, V. Kerry, William Ho Desvousges and M.P. McGivney. 1983. "Estimating Water Quality Benefits: An Econometric Analysis." Southern Economic -50:422-37"

Smith, V. K., W. H. Desvousges and M. P. McGivney. 1983. "The Opportunity Cost of Travel Time in Recreation Demand. Models." Land Economics. 59:3:259-78.

Smith, V. Kerry and Yoshiaki Kaoru. 1985. "The Hedonic Travel Cast Model: A View from the Trenches." Mimeo.

Stevens, J. B. 1966. "Recreation Benefits from Water Pollution Control." Water Resources Research 2:167-182.

Stevens, Joe B. 1866. "Angler Success as a Quality Determinant of Sport Fishery Recreational Values." Transactions of the American Fisheries Society. 95:357-362.

Stoevener, H. H. 1863. "An Economic Evaluation of Water Pollution Control Alternatives: A Progress Report." Water Resources and Economic Development of the West, No. 12, Committee on the Economics of Water Resources Development of the Western Agricultural Economic. Research Council, Salt *Lake* City, 47-59.

Stoevener, H. H. 1864. "Water uee Relationships as Affected by Water Quality on the Yaquina Bay." New Horizons for Resources Research: Issues and Methodology, Western Resources Conference, University of Colorado Press, Boulder, 87-86.

Stone, J.R.M. 1854. The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-1938, Vol L Cambridge University Press, Cambridge.

Strand, I. E. and N. E. Bockstael. 1985. "The Effect *of* Common Sources of Regression Error *on* Benefit Estimation." Working paper, University of Maryland.

Sutherland, R.J. 1881. "A Regional Approach to Estimating Recreation Benefits of Improved Water Quality." Journal of Environmental Economics and Management 9:229-47.

Thayer, Mark. 1981. "Contingent Valuation Techniques for Assessing Environmental Impacts: *Further* Evidence." Journal *of* Environmental Economic● and Management 8:27-44.

Theil, Henry. 1976. Theory and Measurement of Consumer Demand. Vols 1 and 2. Amsterdam.

Tobin, James. 1985. "Estimation of Relationships for Limited Dependent Variables." Econometrics 26:24-36.

U. S. EPA. 1983. Water Quality Standards Handbook, office of Water Regulation. and Standards. Washington, DC.

U. S. Department of Commerce. 1984. "Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1979 (Revised) - 1980, Current Fishery Statistics 8322." Washington, DC.

U, S. Department of the Interior. "1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation." U. S. Fish and Wildlife Service. Washington, DC. Undated.

Vaug ban, W. J. and C. S. Russell. 1982. "Valuing a Fishing Day: An Application of a Systematic Varying Parameter Model." Land Economics 58:450-62.

Vaughan, W. J. and C. S. Russell. 1982. Fresh Water Recretional Fishing: The National Benefits of Water Pollution Control. Washington D. C.:RFF, Inc.

Vaughan, W. J., C. S. Russell, L. P. Gianessi and L. A. Nielsen. "Measuring and Predicting Water Quality in Recreation Related Terms." J." Env. Mgmt. 15:363-380.

Violette, Daniel. 188s. "A Model to Estimate the Economic Impacts *on Recreational* Fishing in the Adirondacks *from* Current Levels of Acidification." Paper presented at the AERE Workshop on Recreation Demand Modeling, Boulder, CO.

Wales, Terence J. 1971. "A Generalised Linear Expenditure Model of the Demand *for* Non-Durable Goods in Canada." Canadian Journal of Eonomics 4:471-84.

Wales, Terence and A. D. Woodland. 1883. "Estimation of Consumer Demand Systems with Binding Non-Negativity Constraints." Journal *of* Econometrics 21:263-85.

Walsh, Richard G. Undated. "*An* Extension of the Contingent Valuation Approach to Estimate the Effect *of* Instream Flow on *Recreational* Demand." Unpublished.

Walsh, R G., D. A. Greenley, R. A. Young, J. R. McKean, and A. A. Pinto. 1978. "Option Values and Recreational Benefits of Improved Water Quality: A Case Study of the South Platte River Basin, Colorado." Rep. EPA-600/5-78-100. U. S. Environmental Protection Agency, Research Triangle Park, N . C.

Walsh, R G., L. D. Sanders, and J. B. Loomis. 1985. Wild and Scenic River Economics: Recreation Use and Preservation Values. American Wilderness Alliance, Englewood, Colorado.

Wegge, Thomas, W. Michael Hanemann and Ivar Strand. 1985. "An Economic Assessment of Marine Recreational Fishing in Southern California." Report submitted to National Marine Fisheries Service Southwest Regional Office.

Wennergren, E. B. and D. B. Nielson. 1970. "Probability Estimates of Recreation Demands." Journal of Leisure Research 2:112-22.

Williams, J. B., T. P. Smith, M. J. Speir, and S. Early. 1983. "1980 Maryland Saltwater Sport Fishing Survey." Maryland Department of Natural Resources Tidewater Administration Report No. TA-CRD-83-1. Annapolis, MD.

Willig, R.D. 1976. "Consumer's Surplus without Apology." American Economic Review 66:589-97.

Willig, R. D. 1978. "Increment Consumer's Surplus and Hedonic Price Adjustments." Journal of Economic Theory 17:227-253.

Wilman, Elizabeth A. 1884. External Costa of Coastal Beach Pollution. Resources for the Future, Washington, DC.

Wilman, Elizabeth. 1985. "Valuing Quality Changes in Recreation Resources." Paper presented at the AERE Workshop on Recreation Demand Modeling, Boulder, CO.

Zellner, A. and Soo-Bin Park. 1879. "Minimum Expected Lose (MELO) Estimators for Functions of Parameters and Structural Coeffiecients of Econometric Models." Journal of the American Statistical Association. 74:365:185-193.

REFERENCES

Bell, F. W. 1968. "The Pope and the Price of Fish." *American* Economic Review 58142-147.

Binkley, Clark S. and W. Michael Hanemann. 1978. The Recreation Benefits *of* Water Quality Improvements: An Analysis *of* Day Trips in an Urban Setting. Washington, D.C. E. P.A.-600/5-78-010.

Bishop, R.C. and T.A. Heberlein. "Simulated Markets, Hypothetical Markets and Travel Cost Analysis: Alternative Method. of Estimating Outdoor Recreation Demand." Working paper no. 187.

Bishop, R. C. and K. Sample. 1886. "Estimating the Value of Variations in Anglers' Success Rate.: An Application of the Multiple-Site Travel Cost Method." Marine Resource Economics 2:1:55-74

Blackburn, A.J. 1870. "An Alternative Approach to Aggregation and Estimation in the Non-Linear Model." Ch. 9 in The Damand for Travel: Theory and Measurement. Edited by R. E. Quandt. D.C. Heath, Lexington.

Bockstael, Nancy, W. Michael Hanemann and Catherine Kling. 1887. "Modeling Recreational Demand in a Multiple Site Framework." Water Resources Research. Forthcoming.

Bockstael, Nancy, W. Michael Banemann and Ivar Strand. 18SS. Measuring the Benefits of Water Quality Improvments Using Recreation Demand Models. Report presented to the B.P.A. under Cooperative Agreement CR-81 143-01-1, Volume II.

Bockstael, N. E., and K. E. McConnell. 1981. "Theory and Estimation of the Household Production Function for Wildlife Recreation." Journal *of* Environmental Economics and Managemont 8:188-214.

Bockstael, N. E., and K. E. McConnell. 1983. "Welfare Measurement in the Household Production Framework." American Economic Review 73:806-814.

Bockstael, N. B., and J. J. Opaluch. 1983. "Discrete Modelling of Supply Response under Uncertainty: The Case of the Fishery." Journal of Environmental Economics and Management 10:125-137.

Bockstael, N. B., I. B. Strand, and W. M. Hanemann. 1987. "Time and The Recreational Demand Model." American Journal of Agricultural Economics 69213-302

Bockstael, N. E. and I. E. Strand. 1987. "The Effect of Common Sources of Regression Error on Benefit Estimates." Land Economics 63:11-20.

Bockstael, N. E., I. E. Strand, and A. Graefe. Economic Analysis of Artificial Reefs: A Pilot Study of Selected Valuation Methodologies. Technical Report #6. Artificial Reef Development Center, Sportfishing Institute. 1986.

Brookshire, D.S., L.S. Eubanks and A. Randall. . 1983. "Estimating Option Prices and Existing Values for Wildlife Resources. " Land Economics 58:1-15.

Brown, Gard nor and Robert Mendelsohn. 1984. "The Hedonic Travel Cost Method." Review of Economics and Statistics 66:427-33.

Brown, W. G., C. Sorhus, B. Chow-Yang, S. Richards. 1883. "Using Individual Observations to Estimate Recreation Demand Functions." " American Journal of Agricultural Economics 65:154-157.

Brown, W. G., C. N. Sorhus, and D. A. Meyer. 1882. "Estimation of *Oregon* Sport-Caught Salmon and Steelhead Values Via the Travel Cost Method." Mimeo, ASSA Meetings, 25 ppa.

Brown, W. G., A. Singh and E. N. Castle. "Net Economic Value *of the* Oregon Salmon-Steelhead Sport Fishery." Journal of Wildlife Management 29(2):266-279.

Burt, Oscar and Durward Brewer. 1872. "Estimation of Net Social Benefits From Outdoor Recreation." Econometrica 39:813.

Carson, R. T. and *R C.* Mitchell 188s0 "The Value of Clean Water: The Public'. Willingness to Pay *for* Beatable, Fishable, and Swimmable Quality Water." Discussion paper No. QE85-08 revised, (Washington, D. C., Resources for the Future).

Castle, Emery N. and W. G. Brown. 1884. "The Economic Value of a Recreational Resource: *A* Case Study of the Oregon Salmon-Steelhead Sport Fishery. Paper presented before the Committee on the Economics *of* Water Resource* Development of the Western Agricultural Economics Research Council, San Francisco, California.

Caulkins, Peter, Richard Bishop and Nicolass Bouwes. 1982. "The Travel Coat Model for Lake Recreation A Comparison of Two Methods *for* Incorporating Site Quality and Substitution Effects." Mimeo, ABA annual meetings,

Caulkins, Peter P., Richard C. Bishop and Nicolass W. Bouwes, Sr. 1888. "The Travel Cost Model for Lake Recreation: A Comparison of Two Methods for Incorporating Site Quality and Substitution Effects." Amer. J. Air. Econ. 68(2):291-297.

Caulkins, Peter, Richard Bishop and Nicolass Bouwes. 1985. "Omitted Cross-Price Variable Biases in the Linear Travel Coat Model: Correcting Common Misperceptions. " Land Economics 61:182-85.

&aario, Frank J. 1969. "Operations Research in Outdoor Recreation." Journal of Leisure Research 1:33-52.

Cesario, Frank J. 1973. "A Generalized Trip Distribution Model." Journal of Regional Science 13:233-48.

Cesario, Frank J. 1974. "More on the Generalized Trip Distribution Model," Journal of Regional Science 14:389-97

Cesario, Frank J. and Jack Knetach. 1976. "A Recreation Site Demand and Benefit Estimation Model." Regional Studies 10:97-104.

Christensen, L. R., Jorgenson, D.W. and Lawrence Lau. 1975. "Transcendental Logarithmic Utility Functions." American Economic Review 65:367-83.

Cicchetti, Charles, Anthony Fisher and V. Kerry Smith. 1976. "An Econometric Evaluation of a Generalized Consumer Surplus Measure: The Mineral King Controversy." Econometrica 44:1268-76.

Cicchetti, C.J., J.J. Seneca and Paul Davidson. 1869. The Demand and Supply of Outdoor Recreation: An Econometric Analysis. Rutgers. 1869.

Clawson, MartOn. 1859. Methods for Measuring the Demand for and Value of Outdoor Recreation. Resources for the Future, Inc., Reprint no. 10.

Clawson, Marion and Jaok Knetach. 1866. Economics of Outdoor Recreation. Resources for the Future, Washington D.C.

Cox, D.R. 1861. "Tests of Separate Families of Hypotheses." Proceedings of the Fourth Berkeley Symposiurn on Mathematical Statistics and Probability, Vol 1. University of California Press.

Cronin, F. J. 1882. "Valuing Non-Market Goods Through Contingent Markets." Rep. PNL-4255, Pac. Northw. Lab., Richland, Wash.

Cropper, M. L., L.B. Deck, K.B. McConnell and T.T. Phipps. 1886. "Should the Rosen Model be Used to Value Environmental Amenities?" Papar presented at the conference on the Economics of Chesapeake Bay Management 11, Annapolis, MD.

Cummings, R G., D. S. Brookshire and W. D. Schulze. 1984. valuing Environmental Goods: A State of the Arts Assessment of the Contingent Valuation Method. Draft report to EPA. Universities of New Mexico and Wyoming. "

Daubert, J. T. and R A. Young. 1981. "Recreational Demands for Maintaining Instream Flows: A Contingent Vaulation Approach." Amer. J. Agr. Econ. 63(4):666-676.

Deaton, A.S. 1974, "The Analysis of Consumer Demand in the United Kingdom, 1800-1970." Econometrics 42:341-67.

Deaton, Henry. 1978. "Specification and Testing in Applied Demand Analysis." Economic Journal 88:524-36.

Desvousges, W. H., V. K. Smith and M. P. McGivney. 1983. A Comparison of Alternative Approaches for Estimation of Recreation and *Related* Benefits *of* Water Quality Improvements. Washington, D. C.: Environmental Protection Agency, Office of Policy Analysis.

Deuel, D. G. 1978. "National Marine Recreational Fishery Statistics Program." Paper presented at Canadian Sport Fisheries Conference, New Brunswick, Canada.

Domencich, Thomas and Daniel McFadden. 1975. Urban Travel Demand: A Behavioral Analysis. North-Holland, Amsterdam.

Dwyer, J. F. and M. D. Bowes. 1978. "Concepts of Value for Marine Recreational Fishing." American Journal of Agricultural Economics 60(5): 1008-10120

Feenberg, Daniel and Edwin Mills. 1980. Measuring the Benefits of Water Pollution Abatement. New York, Academic Press.

Fisher, Ann and William H. Desvousges. 1881. "Alternative Contingent Market Approaches to Valuation of Recreation and Related Benefits of Improved Water Quality." Paper presented at the Eastern Economics Association Meetings, Washington D.C.

Fisher, Am and Robert Raucher. 1982. "Comparison of Alternative Methods of Evaluating the Intrinsic Benefits of Improved Water Qualiy." Paper presented at ASSA meetings, New York City.

Fisher, F. and K. Shell. 1871. "Taste and Quality Change in the Pure Theory *of* the True Cost-of-Living Index." in Price Indexes and Quality Change. Edited by Zvi Griliches. Harvard University Press, Massachusetts.

Freeman, A. Myrick III. 1979. The Benefits of Environmental Improvement: Theory and Practice. Johns Hopkins Press for Resources for the Future, Inc., Baltimore. 1979.

Freeman, A. Myrick III. 1882. Air and Water Pollution Control: A Benefit-Coat Assessment. John Wiley and Sons.

Freund, R. J. and R. R. Wilson. 1974. "*An* Example of a Gravity Model to Estimate Recreation Travel." Journal of Leisure Research 6:241-56.

German, W.M. 1976. "Tricks with Utility Function." in Essays in Econmic Analysis: Proceddings of the 1975 AUTE *Conference*, Sheffeld. Edited by M.J. Artis and A.R. Nobay. Cambridge University Press, Cambridge.

Greenley, Douglas A., Richard G. Walsh and Robert A. Young. 1981. "Option Value: Empirical Evidence from a Case Study of Recreation and Water Quality." Quartelv J. Econ. 96(4):657-673.

Gum, R.L. and W.E. Martin. 1975. "Problems and Solutions in Estimating the Demand for and Value of Rural Outdoor Recreation." American Journal of Agricultural Economics 57:558-66.

Hanemann, W. Michael. 1980. "Quality Changes, Consumer's Surplus, and Hedonic Price Indices." California Experiment Station working paper number 116.

Hanemann, W. Michael. 1981. "Quality and Demand Analysis." Ch. 3 in New Directions in Econometric Modeling and Forecasting in U.S. Agriculture. Edited by Gordon Rausser, Elsevier/North-Holland, New York.

Hanemann, W. Michael. 1882. "Applied Welfare Analysis with Qualitative Response Models." California Agricultural Experiment Station working paper no. 241.

Hanemann, W. Michael. 1984a. "Multiple Site Demand: A Review of Existing Models and New Development", Chapter 9 in Measuring the Benefits of Water Quality Improvements Using Recreation Demand Models. Draft Report presented to E.P.A. under Cooperative Agreement CR-80043-01-0, VOL II.

Hanemann, W. Michael. 1984b. "Discrete/Continuous Models of Consumer Demand." Econometrics 52:541-61.

Hanemann, W. M. 1978. "A Methodological and Empirical Study of Recreation Benefits from Water Quality Improvement." Ph. D. dissertation, Department of Economics, Harvard University.

Hanemann, W. M. 1984. "Welfare Evaluations with Market Data." American Journal of Agricultural Economics. 66:332-41.

Hanemann, W. M. 1984. "Welfare Evaluation in Contingent Valuation Experiment with Discrete Responses." American Journal of Agricultural Economics. VOL 66(3):332-341.

Harmon, R. J. and Associates. 1883. Recreational Resources at Risk. Taak 2 Working Paper. Washington, DC.

Harrison, D. and D. Rubinfeld. 1878. "Hedonic Housing Prices and the Demand for Clean Air." Journal of Environmental Economics and Management 5:81-102.

Hausman, J.A. 1886. "Exact Consumer's Surplus and Deadweight Loss." American Economic Review 71:662-76.

Heintz, H.T. Jr., A. Hershaft and G.C. Horak. 1976. National Damages of Air and Water Pollution. A Report to the EPA. Enviro Control, Inc. Rockville, MD.

Hiett, R. L. and J. W. Worrall. 1977. "Marine Recreational Fisheries Ability to Estimate Catch and to Recall Catch and Effort over Time." Human Sciences Research, Inc., Report HSR-RR-77/18, Washington, D.C.

Horowitz, Joel. 1983. "Statistical Comparison of Non-nested Probabilistic Discrete Choice Models." Transportation Science 17:319-50.

Hotelling, H. 1948. Letter to the National Park Service in "Economics of Outdoor Recreation" - The Prewitt Report.

Huppert, D.D. 1983. NMFS Guideline. on Economic Valuation of Marine Recreational Fishing. NOAA Technical Memorandum NOAA-TM-NMFS-SWFC-32, Department of Commerce, Washington, D.C.

Johnston, J. 1972. Econometric Methods. Second Edition McGraw-Hill, New York.

Just, Richard, Darrell Hueth and Andrew Schmits. 1982. Applied Welfare Economics and Public Policy. Englewood Cliffs, N.J. Prentice-Hall Inc.

Just, R E., and D. L. Hueth. 1979. "Multimarket Welfare Measurement." American *Economic Review* *69947-64.*

Kealy, Mary Jo, and Richard C. Bishop. 1983. "Theoretical and Empirical Specification Issues in Travel Cost Demand Studies." Unpublished.

Kendall, M. and Alan Stuart. 1977. The Advanced Theory of Statistics. 4th Edition, (Vol. 1), New York: MacMillan.

Kling, Catherine. 1986. 'A Simulation Approach to Comparing Multiple Site Recreation Demand Model. Using Chesapeake Bay Survey Data." Paper presented at the Conference *on the Economics of* the Chesapeake Bay Management II, Annapolis, MD.

Kling, Catherine, Nancy Bockstael and Ivar Strand. 1985. "An Evaluation of Multiple Site Model Development." Paper presented at the *AEA* meetings, New York, N.Y.

Kling, Catherine. 1886. **Measuring the Recreational Benefits of Environmental Amenities Using Multiple Site Models: An Evaluation of Techniques.** Ph.D. Dissertation, University of Maryland.

Krutilla, J. V. 1967. "Conservation Revisited." American Economic Review. 57(Sept.):777-86

Lewbel, Arthur. 1975. "A Unified Approach to Incorporating Demographic or Other Effects into Demand Systems." Review *of* Economic Studies 42.

Loomis, J. 1986. "An Examination of the Variation in Empirical Estimates of Site Specific Marginal Values *for* Recreational Fishermen." Working paper, Division of Environmental Studies, University of California, Davis.

Maddala, G. S. 1983. Limited Dependent and Qualitative Variables in Econometrics. Cambridge University Press New *York*.

Maddala, G. S. 1977. Econometric McGraw-Hill, Inc., N. Y. 516 pp.

Maler, Karl-Goran. 1974. Environmental Economics: A Theoretical Inquiry, Baltimore, Johns Hopkins University Press for Resources for the Future.

Mathews, S. B. and G. S. Brown. 1970. "Economic Evaluation of the 1967 Sport Salmon Fisheries of Washington*" Washington Department of Fisheries, Technical Report #2.

McConnell, K. E. and N. E. Bockstael. 1984. "Aggregation in Recreation Economics: Issues of Estimation and Benefit Measurement." Northeastern Journal of Agricultural and Resource Economics 13:181-186.

McConnell, *K. E.* and I. E. Strand. 1981. 'Measuring the Cost of Time in Recreation Demand Analysis." American Journal of Agricultural Economics 63(Feb):153-156.

McConnell, K. B. 1986. Identification of *preference. in* Hedonic Models. Report presented to Environmental Protection Agency under Cooperative Agreement CR-811043-01-0, Vol I.

McConnell, K. E. 1879. "Values of Marine Recreational Fishing: Measurement and Impact of Measurement." American Journal of Agricultural Economics 61(5):921-923.

McConnell, K. E. and T. P. Smith. 1979. "Marine Recreational Fishing in Rhode Island," University of Rhode Island Marine Memorandum #62.

McFadden, Daniel. 1874. "Conditional Logit Analysis of Qualitative Choice Behavior." in Frontiers in Econometrics. Edited by P. Zarembka.

McFadden, D. 1978. "Modelling the Choice of Residential Location. " In Karlquist, Lundquist, Snickars, and Weibull (eds) Spatial Interaction Theory and Planning Models. New York North-Holland Publishing company.

Mendelsohn, Robert. 1984. "Estimating the Structural Equations of Implicit Markets and Household Production Functions." Review of Economics and Statistics 66:673-77.

Meyer, P. A. 1982. Net Economic Values for Salmon and Steelhead from the Columbia River Sustem. NOM Technical Memorandum NMFS F/NWR-3, U. S. Department *of* Commerce, Washington, D.C.

Miller, Jon. 1982. "Valuation Methods for Fish and Wildlife Associated Recreation: An Empirical Comparison of the Travel Coat and Contingent Valuation Method-." Paper presented at the ASSA meetings, New York, N.Y.

Mitchell, R C. and Richard T. Carson. 1984. "National Fresh Water Quality Benefits: Findings from a New National Contingent Valuation Survey." Presented at the annual AERE meeting, Cornell University.

Morey, Edward. 1981. "The Demand for Site-Specific Recreational Activities: A Charactaristics Approach." Journal of Environmental Economics and Management 8:345-71.

Morey, Edward. 1984a. "Characteristics, Consumer Surplus and New Activities: A Proposed Ski Area." Paper presented at the ASSA meetings, Dallas, TX.

Morey, Edward. 1984b. "The Choice of Ski Areas: Estimation of a Generalized CBS Preference Ordering with Characteristics." Review of Economics and Statistics 66:584-90.

Muellbauer, J. "Household Composition, Engel Curvea and Welfare Comparisons Between Households A Duality Approach." European Economic Review 5(1974):103-22.

Norton, V. J., T. P. Smith, and I. E. Strand. 1889. Stripers: The Economic Value of the Atlantic Coast Commercial and Recreational Striped Bass Fisheries. Maryland Sea Grant Publication #UM-SG-TS-83-12.

Pacific Fisheries Management Council. 1886. Review of 1985 Ocean Salmon Fisheries. Portland, Oregon.

Parks, RS. 1969, "Systems of Demand Equations: An Empirical Comparison of Alternative Functional Forma." Econometrics 37:629-65

Pesaran, M.H. and A.S. Deaton. 1978. "Testing Non-nested Non-linear Regression Models." Econometricca 46:677-94.

Pindyck, Robert and Daniel Rubinfeld. 1981. Econometric Models and Economic Forecasts. New York, McGraw-Hill Book Company.

Pow, Robert. 1971. "Additive Utility Functions and Linear Engel Curves." Review of Economic Studies 38401-14.

Pollak, Robert and Terence Wales. 19790 "Estimation of the Linear Expenditure System." Econometrics 37:611-29.

Pollak, Robert and Terence Wales. 1881. "Demographic Variables in Demand Analysis." Econometrics 4*1533-51.

Reiling, S. D., K.C. Gibbs and H.H. Stoevner. 1973. Economic Benefits from an Improvement in Water Quality, Washington,D.C., U.S. EPA.

Ribaudo, Marc O. and Donald J. Epp. 1983. "The Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality." Paper presented at the annual AAEA meeting, Purdue, Indiana.

Rosen, Sherwin. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." Journal of Political Economy 82:34-55.

Rowe, Robert, Edward Morey, Arthur Ross and W. Douglass Shaw. 1985. Valuing Marine Recreation Fishing on the Pacific Coast. Energy and Resurce Consultants, Report prepared for National Marine Fisheries Service, NOAA.

Russell, C. S., and W. A. Vaughan. 1982. "The National Recreational Fishing Benefits of Water Pollution Control." Journal of Environmental Economics and Management 9:328-354.

Samples, K. C., and R. C. Bishop. (Undated). "Estimating Social Value. of Sport Caught Fish A Suggested Approach." Draft, 12 pps.

Samuelson, Paul A. 1947. "Some Implications of Linearity," Review of Economic Studies 15:88-90.

Saxonhouse, G.R. 1977. "Regressions from Samples Having Different Characteri-tics." Review of Economics and Statistics 59294-7.

Schulse, W. D., D. S. Brookshire, B. G. Walther, M. K. McFarland, M. A. Thayer, R. L. Whitworth, S. Ben-David, W. Maim, and J. Molenar. 19S3. "The Economic Benefits of Preserving Visibility in the National Parklands of the southwest." Natural Resources Journal 23:149-173.

Sellar, Christine, John Stoll and Jean-Paul Chavas. 196s. "Validation of Empirical Measures of Welfare Change: A Comparison of Nonmarket Techniques." Land Economics 61:156-75.

Sellar, C., J. P. Chavas and J. R. Stoll. 1966. "Specification of the Logit Model: The Case of Valuation of Nonmarket Goods." Journal 'of Environmental Economics and Managment Vol. 13:382-390.

Smith, V. Kerry and William H. Deavousge. 1985. "The Generalized Travel Cost Model and Water Quality Benefits: A Reconsideration." Southern Economic Journal 62371-81.

Smith, V. K., W. H. Desvousges and Ann Fisher. 1986. "A Comparison of Direct and Indirect Methods for Estimating Environmental Benefits." Amer. J. Agr. Econ. 68(2):280-290.

Smith, V. Kerry, William Ho Desvousges and M.P. McGivney. 1983. "Estimating Water Quality Benefits: An Econometric Analysis." Southern Economic -50:422-37"

Smith, V. K., W. H. Desvousges and M. P. McGivney. 1983. "The Opportunity Cost of Travel Time in Recreation Demand. Models." Land Economics. 59:3:259-78.

Smith, V. Kerry and Yoshiaki Kaoru. 1985. "The Hedonic Travel Cast Model: A View from the Trenches." Mimeo.

Stevens, J. B. 1966. "Recreation Benefits from Water Pollution Control." Water Resources Research 2:167-182.

Stevens, Joe B. 1866. "Angler Success as a Quality Determinant of Sport Fishery Recreational Values." Transactions of the American Fisheries Society. 95:357-362.

Stoevener, H. H. 1863. "An Economic Evaluation of Water Pollution Control Alternatives: A Progress Report." Water Resources and Economic Development of the West, No. 12, Committee on the Economics of Water Resources Development of the Western Agricultural Economic. Research Council, Salt *Lake* City, 47-59.

Stoevener, H. H. 1864. "Water uee Relationships as Affected by Water Quality on the Yaquina Bay." New Horizons for Resources Research: Issues and Methodology, Western Resources Conference, University of Colorado Press, Boulder, 87-86.

Stone, J.R.M. 1854. The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-1938, Vol L Cambridge University Press, Cambridge.

Strand, I. E. and N. E. Bockstael. 1985. "The Effect *of* Common Sources of Regression Error *on* Benefit Estimation." Working paper, University of Maryland.

Sutherland, R.J. 1881. "A Regional Approach to Estimating Recreation Benefits of Improved Water Quality." Journal of Environmental Economics and Management 9:229-47.

Thayer, Mark. 1981. "Contingent Valuation Techniques for Assessing Environmental Impacts: *Further* Evidence." Journal *of* Environmental Economic● and Management 8:27-44.

Theil, Henry. 1976. Theory and Measurement of Consumer Demand. Vols 1 and 2. Amsterdam.

Tobin, James. 1985. "Estimation of Relationships for Limited Dependent Variables." Econometrics 26:24-36.

U. S. EPA. 1983. Water Quality Standards Handbook, office of Water Regulation. and Standards. Washington, DC.

U. S. Department of Commerce. 1984. "Marine Recreational Fishery Statistics Survey, Atlantic and Gulf Coasts, 1979 (Revised) - 1980, Current Fishery Statistics 8322." Washington, DC.

U, S. Department of the Interior. "1980 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation." U. S. Fish and Wildlife Service. Washington, DC. Undated.

Vaug ban, W. J. and C. S. Russell. 1982. "Valuing a Fishing Day: An Application of a Systematic Varying Parameter Model." Land Economics 58:450-62.

Vaughan, W. J. and C. S. Russell. 1982. Fresh Water Recretional Fishing: The National Benefits of Water Pollution Control. Washington D. C.:RFF, Inc.

Vaughan, W. J., C. S. Russell, L. P. Gianessi and L. A. Nielsen. "Measuring and Predicting Water Quality in Recreation Related Terms." J." Env. Mgmt. 15:363-380.

Violette, Daniel. 188s. "A Model to Estimate the Economic Impacts *on Recreational* Fishing in the Adirondacks *from* Current Levels of Acidification." Paper presented at the AERE Workshop on Recreation Demand Modeling, Boulder, CO.

Wales, Terence J. 1971. "A Generalised Linear Expenditure Model of the Demand *for* Non-Durable Goods in Canada." Canadian Journal of Eonomics 4:471-84.

Wales, Terence and A. D. Woodland. 1883. "Estimation of Consumer Demand Systems with Binding Non-Negativity Constraints." Journal *of* Econometrics 21:263-85.

Walsh, Richard G. Undated. "*An* Extension of the Contingent Valuation Approach to Estimate the Effect *of* Instream Flow on *Recreational* Demand." Unpublished.

Walsh, R G., D. A. Greenley, R. A. Young, J. R. McKean, and A. A. Pinto. 1978. "Option Values and Recreational Benefits of Improved Water Quality: A Case Study of the South Platte River Basin, Colorado." Rep. EPA-600/5-78-100. U. S. Environmental Protection Agency, Research Triangle Park, N . C.

Walsh, R G., L. D. Sanders, and J. B. Loomis. 1985. Wild and Scenic River Economics: Recreation Use and Preservation Values. American Wilderness Alliance, Englewood, Colorado.

Wegge, Thomas, W. Michael Hanemann and Ivar Strand. 1985. "An Economic Assessment of Marine Recreational Fishing in Southern California." Report submitted to National Marine Fisheries Service Southwest Regional Office.

Wennergren, E. B. and D. B. Nielson. 1970. "Probability Estimates of Recreation Demands." Journal of Leisure Research 2:112-22.

Williams, J. B., T. P. Smith, M. J. Speir, and S. Early. 1983. "1980 Maryland Saltwater Sport Fishing Survey." Maryland Department of Natural Resources Tidewater Administration Report No. TA-CRD-83-1. Annapolis, MD.

Willig, R.D. 1976. "Consumer's Surplus without Apology." American Economic Review 66:589-97.

Willig, R. D. 1978. "Increment Consumer's Surplus and Hedonic Price Adjustments." Journal of Economic Theory 17:227-253.

Wilman, Elizabeth A. 1884. External Costa of Coastal Beach Pollution. Resources for the Future, Washington, DC.

Wilman, Elizabeth. 1985. "Valuing Quality Changes in Recreation Resources." Paper presented at the AERE Workshop on Recreation Demand Modeling, Boulder, CO.

Zellner, A. and Soo-Bin Park. 1879. "Minimum Expected Lose (MELO) Estimators for Functions of Parameters and Structural Coeffiecients of Econometric Models." Journal of the American Statistical Association. 74:365:185-193.

Appendix A

The Random Digit Dialing Survey Telephone Procedures

For the Random Digit Dialing Survey, three instruments (copies included in the Appendix) were developed: a two-page screening form, an 11-page, 28-item questionnaire, and a Record of Calls sheet.

1. Screening Form

The screening form was intended to determine the eligibility of the location served by a randomly generated telephone number. The number was printed on a label affixed to the top of the screening form. Pay phones and phones used only by businesses were not considered eligible, since people answering such telephones would be eligible at their residence phone.. In addition, if the household served by the phone was not located within the counties/cities making up the selected SMSA's then that phone (residence) was not eligible. Once an eligible phone (residence) was identified, a member of the household who was 18 years of age or older was required. If all residents were under 18, the screening was completed with a member of the household who was 14 or older.

The screening form was composed of five sections: an Identification section consisting of an area code, telephone number, and five-digit case identification number, all printed on the aforementioned label; a brief introduction to be read by the interviewer which explained the study; a screening section which was used to eliminate pay phones, businesses without living accommodations. and residences not located in certain specific SMSA's; a screening status section to record the screening eligibility of the location; and a questionnaire status section to record whether or not a questionnaire was completed with an eligible person.

2. Questionnaire

The Random Digit Dialing Survey Questionnaire was intended to determine the following:

Use or intent to use the Chesapeake Bay for recreation during 1984; Reasons for nonuse;

Activities that the respondent (and his/her family) participated in while visiting beaches;

Reasons the respondent or other members of his/her family do not go in the water during visits to the western shore beaches;

Changes in swimming participation in the Chesapeake brought about by change. in the water quality;

The respondent's perception of the water quality in the Chesapeake;

The value respondents place on the Bay and how they visualize that improvement should be made and financed.

As in the User Intercept Survey, a series of demographic questions which will enable analysts to establish profiles of beach users and nonuser were included in the questionnaire.

The Random Digit Dialing Survey Questionnaire waa also divided into sections. The first, Identification, had space provided for recording the case ID number from the screening forms the telephone interviewer's initials, and the date the interview was completed. The second section, as in the User Intercept Survey, was a lengthier introduction to be read by the telephone interviewer, which went into greater detail regarding the purpose of the survey and contained statement informing the respondent *of* the voluntary nature of his/her participation in the study and assurances *of* the confidentiality of the data collected. The third section, Recreational Uae of the Chesapeake Bay, sought specific responses which would: (1) enable analysts to determine if and how the beaches were used and (2) what the overall perception of the water quality waa. Thie waa followed by a fourth and final section consisting of some 18 demographic questions.

Data Collection Methods

Two field interviewers were trained in Baltimore for the data collection of the Ueer Intercept Survey on May 25, 1884. A Field Interviewer Manual was developed (which is available upon request) and included quemtion-by-question specification, probing techniques, confidentiality procedures, refusal conversion strategies, and other measure● necessary to assure the collection of standardized, quality data during the course of the field survey process. Alao covered in the manual were: background information, assignment information, sampling procedures and administrative procedures.

The *final* day *of* field work on the ueer survey was August 16, 1984. The confirmation portion of the user survey was completed on September 1. The following represents the response rates *for* the field work:

Table A.1

Response Rates *for* Beach User Survey

Sample Individual	Successfully screened	Eligible Individuals	Eligible Individuals Interviewed
468	463	414	408
(100%)	(98.79%)	(100%)	(88.55%)

Of the 468 individuals screened, 60 were not administered questionnaires for the folowing reasons:

Ineligible because of residence	39
Refused screening	7
Language barrier-screening	6
Other	2
Refused questionnaire	3
Language -barrier - questionnaire	3

Regarding the confirmation portion of the ueer survey, 340 of the people interviewed gave telephone numbers or come other piece of information through which contact could be made to conduct a confirmation/intention interview. Approximately 240 (71 percent) of these individuals were successfully contacted during the time period allowed.

Training of telephone interviewers for the Random Digit Dialing Survey started on July 23. A total *of 11* telephone interviewer. were hired with three *of* these spending the majority *of* their time making confirmation/intention calls to participants in the User Intercept Survey.

As in the User Intercept Survey, each interviewer received a copy of a Telephone Interviewer Manual specifically developed for this phase of the project, as well as copies of the Random Digit Dialing instruments. The Telephone Interviewer Manual (available upon request) included question-by-question specification, probing techniques, confidentiality porcedures, refusal conversion ● trategiea, and other measures necessary to assure the collection *of* standardized, quality data during the course of the telephone ● nvey process.

Approximately 192 telephone interview. were completed with western shore beach users. The remainder consisted of approximately 804 nonusers and 48 intended users. The following two tables represent questionnaire completions per strata and final totals *for* screening and questionnaire status codes.

Table A.2

Questionnaire Completions Per Strata

Stratum Number	Cases Avail.	Cases Assigned	Quest. Complete	Quest. Partial	Total Quest.	Quest. Needed	Diff.
1	1,230	1,060	155	10	165	138	+ 27
2	1,100	1,000	225	7	232	220	+ 12
3	408	408	70	0	70	77	- 7
4	1,014	1,014	96	4	100	112	- 12
5	820	820	171	6	177	158	+ 19
6	1,560	1,560	293	7	300	295	+ 5
Totals	6,132	5,962	1,010	34	1,044	1,000	-44

Table A.3

Final Telephone Result Totals for Screening and Questionnaire Status Codes

Screening Status Codes

Eligible Identified/Screener Completed	1,108
Nota Working Telephone Number	2,866
Pay Telephone	13
Business Telephone	843
No Answer After Repeated Calls	897
Telephone Not Located in Bait./Wash. SMSA	11
No Eligible Respondent Available After Repeated Calls	10
Refused to Answer Screening Questions	203
Language Barrier O	9
Other	3

Questionnaire Status Codes

Questionnaire Completed	1,010
Questionnaire Partially Completed	34
Language Barrier	0
Questionnaire Refused	63
Other	1

Appendix B

Telephone Survey instrument

CHESAPEAKE BAY BEACH USE SURVEY
TELEPHONE SCREENING FORM

A. IDENTIFICATION

TsuPllGNs NUMBER (_)-___-____ CASE ID NUMBER [| | |]

B. INTRODUCTION

I am calling from the Research Triangle Institute near Raleigh, North Carolina to conduct a telephone survey about the Chesapeake Soy for the University of Maryland. To find out if I've contacted the proper type of place, I need to ask a few simple questions. First,

C. SCREENING

1. Is this telephone number (READ THE 7-DIGIT NUMBER ABOVE) in a rea code (READ 3-DIGIT AREA CODE ABOVE)?

No [1] (RANG UP AND DIAL NUMBER AGAIN) (1)
Yes [2]

2. Is this a pay phone?

No [1] (2)
Yes [2] (GO TO 6)

3. a. Is this telephone located in a private residence or a business?

Private residence [1] (GO TO 4a) (3)
Business [2]

b. Aro there any living accomodations at this place of business?

No [1] (GO TO 6) (4)
Yes [2]

e. Do the people living there use this phone for their calls?

No [1] (GO TO 6) (5)
Yes [2]

d. Whoa can I speak to one of the people who lives at this business location and uses this telephone for personal calls?
ANSWER: _____
(CALL BACK IF NECESSARY TO COMPLETE SCREENING)

4. a. Are you a member of the household serviced by this telephone?

No [1]
Yes [2] (m TO So)

b. When will a member of the household be available to talk to me?
ANSWER: _____
(CALL BACK IF NECESSARY TO COMPLETE SCREENING)

S. a. Is this residence located in Maryland, Virginia, Washington, DC or some other place?

Maryland [1] (GO TO b) (6)
Virginia [2] (GO TO b)
Washington, DC [3] (GO TO 7)
Some other place [4] (GO TO 6)

b. In whet county is this residence located?
ANSWER: _____ (RECORD ANSWER AND CODS BELOW) (7)

MARYLAND
(Anne Arundel, Baltimore including city, Carroll, Charles, Harford, Howard, Montgomery, Prince Georges ..... [1] (GOTO 7)

VIRGINIA
(Arlington, Fairfax, Loudon, and Prince William. Also include Alexandria city, Fairfax city and Falls Church city ..... [2] (GO TO 7)

6. I'm sorry but we are not interested in talking to people (at Pay telephones/at business telephones/in the ● *rea* where *YOU* live). Thank You for ● svermg my questions ● nd could I hove *your 0000* in case my supervisor wants to check my work?
NAME _____ (COMPLETE SCREENING STATUS IN PART D ONLY)

7. ●\ This telephone is located ● ts residence in ● ● rea where we ● re interested in talking to people. Are *you under 18* years of ● ge or over 18 years of ● ge?

under 18 [1] (GO TO b)

over 18 [2] (GO TO c)

b. Whoa will I be ● bLo to talk to someone over 18 years of ● ge who lives in this household? *ANSUER:* _____
(CALL BACK IF NECESSARY TO VERIFY ANSWERS AND COMPLETE QUESTIONNAIRE. IF ALL RESIDENTS ARE UNDER 18 PROCEED WITH ANY RESIDENT 14 OR OLDER.)

c. How many telephones with different numbers, not ● xtensions, service this household? [ ][ ] (8-9)

d. May I have your name ia case my supervisor wants to check my work?
NAME _____ (PROCEED TO QUESTIONNAIRE BUT RETURN TO AND CODE SCREENING STATUS AND QUESTIONNAIRE STATUS AFTER QUESTIONNAIRE ADMINISTRATION.)

D. **SCREENING STATUS CODES**

Eligible Identified/Screener Completed ..... [01]
Not a Working Telephone Number ..... [02]
Pay Telephone ..... [03]
Business Telephone ..... [04] (10-11
No Answer After Repeated Cello ..... [05]
Telephone Not Located In Balt./Wash. S.M.S.A. ..... [06]
No Eligible Respondent Available After Repeated Calls ..... [10]
Refused To Answer Screening Questions ..... [97]
Language Barrier ..... [11]
Other ..... m I

E. **QUESTIONNAIRE STATUS CODES**

Questionnaire Completed (No mail followup) ..... [01]
Questionnaire Completed (Mail followup) ..... [02]
Questionnaire Partially Completed ..... [03]
Language Sorrier ..... [04] (12-13
Questionnaire Refused ..... [97]
Other ..... [06]

COLS. 14-73 =blank
COLS. 74-80 =CASE 01

CHESAPEAKE BAY TELEPHONE SURVEY QUESTIONNAIRE

Conducted by Research Triangle Institute
for the University of Maryland

A. IDENTIFICATION

CASE ID [| | | | |]

Interviewer Initials _____

Date Interview Completed [| |] [| |]
Month Date

B. INTRODUCTION

As I said earlier, researchers at the University of Maryland are currently studying citizens' use of the Chesapeake Bay. I will ask you some questions regarding your recreational use of the Chesapeake Bay, particularly at the beaches. I also have to ask some questions which will enable the researchers to establish profiles of typical users and non users of the Bay. There is no direct benefit from taking part in this study and you have the right to refuse to answer any or all of the questions or discontinue your participation at any time. The information that you provide will be combined with that provided by other people who participate in the survey to assure complete confidentiality and your same will not be released or revealed to anyone other than authorized project staff. The results of this survey may be helpful in effectively allocating mosey to cleaning up the Bay.

c. RECREATIONAL USE OF THE CHESAPEAKE BAY

1. Have you or any members of your household used the Chesapeake Bay for recreation in 1984?

No . . . . . [1] (GO TO Q. 2.)

Yes . . . . . [2] (GO TO Q. 4.)

2. DO you or any members of your household intend to use the Chesapeake Bay for recreation during the rest of 1984?

No. . . . . [1] (GO TO Q.3.)

Yes . . . . . [2] (GO TO Q.4)

3. What are the reasons you and members of your household have not used and do not intend to use the Chesapeake Bay for recreation during 1984? (CODE ALL RESPONSES GIVEN INTO-THE CATEGORIES BELOW)

		CODE IF GIVEN
a.	Not interested in water related recreation	[2]
b.	Unable for health reasons	[2]
c.	Costs too much	[2]
d.	Takes too much time to get there (too far to travel).	[2]
e.	Unacceptable water quality	[2]
f.	Too many jellyfish	[2]
g.	Too crowded	[2]
h.	Have not had a chance (too busy)	[2]
i.	Other	[2]

(GO TO Q. 8.)

4. What activities did or will you (and/or members of your household) participate in while using the Chesapeake? (READ EACH OF THE FOLLOWING AND INDICATE PARTICIPATION FOR EACH ACTIVITY.)

		NO	YES	
a.	Fishing. . . . . 0 . . .	1	2	(
b.	Swimming	1	2	(
c.	Boating.	1	2	(
d.	Hunting.	1	2	(
e.	Beach Activities	1	2	(
f.	Sightseeing.	1	2	(
g.	Other.	1	2	(

5. This next question also pertains to YOU and members of your household. During 1984 did any of you or will any of you... (READ THE FOLLOWING.)

		NO	YES	
a.	Visit beaches on the Eastern Shore of the Chesapeake, for example shores close to Cambridge, Salisbury or Chestertown?	1	2	(
b.	Visit beaches on the ocean, such as Ocean City?	1	2	(
c.	Go swimming from a boat in the Chesapeake?	1	2	(
d.	Go swimming in public or private swimming pools? .	1	2	(
e.	Visit beaches on the Western Shore of the Chesapeake, for example beaches near Baltimore, Annapolis, Prince Frederick or Lexington Park? . . .	1	2	(

(IF YES TO PART e., ASK f. IF NO TO PART e, GO TO QUESTION 8.)

f.	During visits to Western Shore beaches did or will anyone attend but not go in the water for any reason?	1	2	(

(IF YES TO PART f, GO TO Q. 6. IF NO TO PART f, GO TO Q. 7.)

6. What are the reasons you or others do not go in the water during visits to the Western Shore beaches?

Do (READ EACH PART AND CODE NO OR YES.)

		NO	YES
a.	You or they believe the water is dirty/polluted	1	2
b.	You or they believe there are too many jellyfish	1	2
c.	You or they have some other reason	1	2

7. Can you tell me which Western Shore beaches you (and your family) have visited in 1984 or plan to visit during the rest of this year? *(CHECK NO* OR YES FOR EACH BEACH LISTED.)

	BEACH	VISITED NO	YES
a.	Sandy Point St. Park	1	2
b.	Fort Smallwood	1	2
c.	Bay Bridge Beach	1	2
d.	Herrington Harbor	1	2
e.	Kurtz Pleasure Beach	1	2
f.	Camp Merrick	1	2
g.	Breezy Point Beach	1	2
h.	Chesapeake Beach	1	2
i.	North Beach	! XI	2
j.	Rod and Reel Dock	1	2
k.	Point Lookout St. Park	1	2
1.	Elm's Beach	1	2
m.	Morgantown Beach	1	2
n.	Miami Beach (Baltimore)	1	2
o.	RockyPointPark	1	2
p.	Conrad'sRuthVilla	1	2
q.	PorterNewPark	1	2
r.	Other (SPECIFY) _____	1	2

8. **Have you (or** members of your **family who live with** your) ● *ver* changed your **swimming** participation in the Chesapeake because of changes *in* the Bay's water quality?

No. . . . . [1] (GO **TO Q. 9.**) . (4(

Yes (stopped). . [2]

Yes (started). . [3]

a. In what year did you (or members *of* your **family) last change your swimming habits in the Chesapeake because of changes in** the Bay's water quality?

Year. . . . . [|] (4

9. We would like to find out how people currently perceive the water quality in the Chesapeake Bay.

●\ Do **you consider the water quality in the** Chesapeake to be ● cceptable or unacceptable for **swimming** ● rid/or other water ● ctivities.

Acceptable . . . . . [1] (4

Unacceptable . . . . . ● m

b. Do you believe the **water** quality varies ● **t** different beaches ● ions the Western Shore of the Chesapeake?

No. . . . . [1] (GO **TO** CHECKPOINT I.) (5

Yes . . . . . [2]

c. **(IF** YES, **SAY:)** In **general,** which statement best describes your beliefs?

The water quality is better North of Annapolis . . [1] (5

The *water* quality is better South of Annapolis . . [2]

INTERVIEWER CHECKPOINT I

REFER TO QUESTION **9.A.** .

WAS THE WATER QUALITY IN THE CHESAPEAKE RATED AS UNACCEPTABLE?

No . . . . . [1] **(GO TO Q. 11.)**

Yes. . . . . [2] (GO **TO CHECKPOINT** TABLE.)

CHECKPOINT TABLE

ENTER THE LAST DIGIT OF THE CASE ID NUMBER HERE. _____

IF THE LAST DIGIT IN THE CASE ID NUMBER IS	CIRCLE AND USE THIS AMOUNT IN QUESTION 10
1	**$5.00**
2	$10.00
3	**$15.00**
4	**$20.00**
5	**$25.00**
6	**$30.00**
7	$35.00 "
8	**$40.00**
9	**$45.00**
0	$50.00

10. **You indicated that in your opinion the water quality** in the Chesapeake **is** unacceptable for **swimming. Would** you be willing to **pay** (AMOUNT **FROM CP** TABLE) in ●xtra **state** *or* **federal** taxes **per year, if** the **water quality** were improved so that you found it ●cceptable to **swim** in the Chesapeake?

No. . . ". . . . 01
Yes . . . . . ● Z
Don't know 98

D. BACKGROUND INFORMATION

11. The next few questions ●re ●bout you ●nd your household. How many of ●ach of the following types of people live in your household? **(READ** EACH **OF THE** FOLLOWING AND ENTER **THE NUMBER** OF EACH TYPE.)

a. Adults **(age** 18 ●nd older) . . . . . [ ]

b. Children between the ●ges *of* **14** ●nd 18 . . . . . [ ]

c. Children **under age of 14** . . . . . [ ]

12. What best **describes your status in the household?**

a. Grandparent. 1
b. **Parent** 2
c. Child. . . . , ... 3
d. Other relative 4
e. I live ●lone or with unrelated individuals . . . 5

13. How many years have you (and your family) lived in either Maryland, Virginia, or Washington, DC?

Number of years . . [1] (63-

14. **Do you or any other members of your household own (READ THE FOLLOWING)...**

		NO	YES	DK	RF	
a.	a boat?	01	02	98	97	(65-
b.	a boat trailer?	01	02	98	97	(67-
c.	fishing tackle (rod, reel, tackle box, etc.)?	01	02	98	97	(69-
d.	a recreational vehicle (RV)?	01	02	98	97	(71-

COLS. 73-80 = ID CASE 01

e.	swimming pool?	01	02	98	97	(1-2
f.	Other recreational items (SPECIFY)					
	_____	01	02	98	97	(3-4
	_____	01	02	98	97	(5-6

15. Are **you one of the** principal **wage** earners in *your* household, **a wage earner but not the principal wage earner, or are you a** homemaker, **a** student or retired?

a. One *of* **the** principal **wage** earners **in** the family . . . . . [1]
b. A **wage** earner but not the principal **wage earner** . . . . . [2]
c. Homemaker. . . . . [3] (7)
d. Retired. . . . . [4]
e. Student. . . . . [5]
f. Other (SPECIFY) _____

_____ [6]

INTERVIEWER NOTE: ASK QUESTIONS 16 **THROUGH** 19 IF CODE 1 OR 2 **IS MARKED** IN QUESTION 15 OTHERWISE GO **TO QUESTION 20.**

16. How many hours **do you usually** *work per* week?

Hours . . . . . [|] (8-

17. How many paid vacation days **will you have altogether in 1984, including** those you've already taken?

Vacation Days . . [|] (10-

18. For ● typical recreational **outing, if you did not go, could you work ● t some paying job instead?**

No 1

Yes 2

19. If you could have worked, what hourly wage might you have been paid specifically for the hours you worked?

a. $3.35/hour 01

b. $3.36 - $5.00/hour 02

c. **$5.00 - $7.50** 03

d. $7.50 - $10.00/hour . . . ● m

●. $10.00- $15.00/hour 05

f. $15.00 - $20.00/hour 06

g. $20.00 - **$25.00/hour** 10

h. **Over $25.00/hour** 11

i. **Don't know** 98

j. Refuse. 97

20. Are **there ● ny** (other) major wage ● **arners** in your family?

No . . . . . 1 **(GO TO Q. 25.)**

Yes 2

The next few questions ● re ● bout the other major wage ● *arner.*

21. How **many hours does he/she usually work per week?**

Hours . . . . . [ ]

22. **How many** paid vacation days will he/she have ● ltogether in **1984?**

Vacation Days . . [ ]

23. **For** the typical recreational **outing,** if he/she did not **go** could he/she work-at some paying job **instead?**

No 1

Yes 2

24. If **he/she** could have worked, what hourly rate would he/she have been paid specifically for the hours worked?

a. $3.35/hour 01
b. $3.36 - $5.00/hour 02
c. $5.00 - $7.50 03
d. $7.50 - $10.00/hour 04
e. $10.00 - $15.00/hour 05
f. $15.00 - $20.00/hour 06
g. $20.00 - $25.00/hour 10
h. Over $25.00/hour . . . . . m
i. **Don't know** 98
j. **Refuse**. 97

25. We **need on estimate of your** household's **income** for **all** of. 1984. I will read **a** series **of** income categories. **Please** stop **me** when I read the **category** which best describes the total **amount** of income **all** members of your household will receive during 1984.

INTERVIEWER CHECKPOINT II

ENTER **THE LAST** DIGIT OF TIE CASE **ID NUMBER HERE.** _____

IF THE LAST DIGIT IS	**START READING THE ANSUER CHOICES** AT
1,3, s,7,9	**a. less than $5,000 AND ASCEND**
2,4, 6,8,0	**1. over $100,000** AND DESCEND

---

a. less **then $5,000** . . . 01
b. **$5,000** to $10,000 . . 02
c. $10,000 to $20,000 . . 03
d. $20,000 to $30,000 . . 04
e. $30,000 to $40,000 . . 05
f. $40,000 to $50,000 . . 06
g. $50,000 to $60,000 . . 10
h. $60,000 to $70,000 . . 11
i. $70,000 to $80,000 , . 12
j. $80,000 to $90,000 . . 13
k. $90,000 to $100,000. . 14
1. Over $100,000 15

Don't know 98

Refused 97

26. CODE SEX BASED ON **NAME,** PREVIOUS **ANSWERS/REMARKS OR** /SK: /re **you** female or *male?*

Female . . . . . [1] (25)

Hale . . . . . [2]

27. Which racial group **do** you identify **with?** (26)

White . . . . . [01]

Black . . . . . [02]

Oriental . . . . . [03]

Other **(SPECIFY)**_____ [04]

Refused. . . . . ." [97]

Don't know . . . . . [98]

COLS. 28-73 = blank
COLS. 74-80 = **CASE** 02i

28. a. This is the last question. We would like to send short questionnaires about the **Chesapeake Bay to people through the mail. We would include a postagepaid envelope to** return the completed questionnaire, so it would not cost anything to mail it **back to us.**

Would you be willing to receive and complete such a questionnaire?

No. . . . . 1 (GO TO C.)

Yes . . . . . 2 (GO TO b.)

b. What is your mailing address?

(VERIFY NAME) _____

_____
(P.O. Box/Street number and name)

_____
City State Zip

ENTER CASE ID NUMBER | | | | | |

c. **Thank you for taking time to answer our questions. Your responses will be very helpful in determining the status of swimming and other activities on the Chesapeake Bay.**
IF YES TO 28a. ALSO **SAY:** When the questionnaire comes **through** the mail, please **complete and return it as quickly as possible.**